

Indo-French Centre for the Promotion of Advanced Research

About the Report

India and France have a long collaborative relationship in various fields of basic and applied research. Among these the active areas of joint research are in Mathematics, Material Science, Space Science, and Infectious diseases. Major initiatives have been undertaken periodically to further strengthen the research partnership between the two countries. One important outcome of this partnership is the establishment of IFCPAR/CEFIPRA [Indo-French Centre for Promotion of Advanced Research]/[Centre Franco-Indien pour la Promotion de la Recherche Avancée] — a bilateral institution, created in 1987, to strengthen the Science, Technology, and Innovation (STI) partnership between the two countries.

The report undertakes a detailed investigation of the role this institution has played in the last 25 years of its existence and based on this assessment gives suggestions for enhancing its engagement for further strengthening the Indo-French STI partnerships. The report draws attention to the value of the knowledge which has been created through the institutes' funding of scientific and industrial research projects, the role this institute has played in strengthening linkages among the individual scientist and institutions of the two countries, enhancing human resource competency in STI of both the countries, and how it has supported translational research that has led to some significant economic and/or social outcomes.

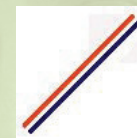
CEFIPRA over the years has broadened its role, keeping in view the changing dynamics of global science and technology, the research demands of both the countries, and the global challenges. How CEFIPRA activities are influencing the overall STI programmes and contemporary engagements between the two countries has also been explored in this study.

CSIR-NISTADS

CSIR-National Institute of Science, Technology and Development Studies (CSIR-NISTADS) is one of the leading institutions under CSIR exploring interface between science, technology, and society. The institute as a knowledge-generating organization carries out studies in several areas of national importance, for example, S&T policy, innovation, national competitiveness in global context, CSIR and public funded knowledge and technology, mapping knowledge trends, and outcomes in S&T. It also undertakes studies on history and philosophy of science and technology (S&T), and S&T for weaker sections.



Indo-French Centre for the Promotion of Advanced Research



CEFIPRA 25 Years



Indo-French Centre for the Promotion of Advanced Research



CEFIPRA-25: Strengthening Bilateral Collaboration and Cooperation in Science, Technology, and Innovation between India and France

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The Indo-French Centre for Promotion of Advanced Research – CEFIPRA is a model bilateral organization for international collaborative research in advanced areas of science and technology. The Centre was established in 1987 with the support from the Department of Science & Technology, Government of India and the Ministry of Foreign Affairs, Government of France. The Centre sustains its programmes through grant-in-aid received from the Governments.

Programme Profile of CEFIPRA

Scientific Research Programme

CEFIPRA supports high quality research groups through collaborative research projects in advanced areas of basic and applied science to nurture scientific competency.

Industrial Research Programme

To promote linkages between Industry and Academia of France and India by leveraging the research skills of Academia to enhance the competitiveness of the Industrial partner involved.

Seminars / Workshops / Summer & Winter Schools/ Training Programmes

For enabling knowledge-sharing on science and technology in areas of current relevance. Such events help in Initiating interactions among scientists and technologists of the two nations and are expected to result in collaborative research projects.

Targeted Programmes

To provide a platform to the national funding agencies of both the countries to come together for supporting collaborative research activities in specific thematic areas of Science and Technology.

Mobility support programme

A programme for dedicated support to the Indian and French students for exposing them to the ST&I environment of the partnering country. The goal of the programme is to strengthen the human resource supply-chain to the ST&I eco-systems by building up the research capacity of the students and catalysing long-term relationships between them across the two nations.

Innovation programme

- Appreciating the willingness of private sectors to contribute to the Indo-French scientific collaboration and their wish of using the experience of CEFIPRA to pursue their objectives, CEFIPRA has developed its Innovation Programme.

Disclaimer

The opinions, estimates, and finding contained in the research reports are based on the information available at the date of publication. Readers are responsible for assessing the relevance and accuracy of the content of this publication. The views in this report are those of the authors, and do not represent those of CEFIPRA. Inquiries may be addressed to the principal author.



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Sujit Bhattacharya
Principal Investigator



Executive Summary

IFCPAR/CEFIPRA (Indo-French Centre for Promotion of Advanced Research/Centre Franco-Indien pour la Promotion de la Recherche Avancée) was established in 1987 as a bilateral institution to act as a nodal entity to facilitate science and technology collaboration between India and France. CEFIPRA recently completed 25 years of its establishment. This study was undertaken to explore and assess the contribution of this institution towards developing knowledge partnership between India and France. The partnership between India and France has expanded in a number of areas and many new engagements have been undertaken for strengthening this partnership further. Both the countries have now strongly stressed upon utilizing their complementary strength to promote innovation that can help in exploiting the knowledge created for economic and/or social outcomes. Mechanisms that would provide an opportunity for different stakeholders — private industries and Small and Medium Enterprises (SMEs) — of both the countries to participate in this process, are being developed. In this new scenario CEFIPRA is expanding its role to provide a platform for facilitating these new initiatives. The study also examined how CEFIPRA is developing new mechanisms for playing a more effective role in catalysing the different phases of the innovation cycle; linking

the Indo-French Science Technology and Innovation (STI) ecosystem.

The assessment of CEFIPRA is done by identifying the STI capacity creation, human resource development, linkages between researchers and institutions of the two countries, knowledge outputs and outcomes that have emerged from the projects funded by this institution, seminars/workshops, student mobility, and other intervention mechanisms of this institution. The study highlights how CEFIPRA funding provides a formal institutional mechanism to carry forward the knowledge exchange, focuses on a problem domain of high promise and scientific significance, and exploits the complementary strengths of researchers of both the countries to solve complex scientific problem.

Indian and International Collaboration of Science, Technology, and Innovation

Numerous studies have shown the positive role of international collaboration in strengthening the scientific and technological competency of a country. This has provided motivation to different countries for encouraging international STI collaboration by signing bilateral agreements, developing targeted joint programmes, creating formal structures, and developing various mechanisms for facilitating

cooperation. India has also, in her science and technology programme, placed international STI collaboration on priority. Bilateral S&T agreements have been signed with more than forty countries, serving as a legal and political frame for cooperation. The Department of Science and Technology (DST) in India is the nodal department responsible for the development and implementation of these agreements. With some countries the international engagement has progressed with more intensity leading to the establishment of bilateral S&T centres: Indo-French Centre for Promotion of Advanced Research, Indo-German S&T Centre, Indo-Russian S&T Centre, Indo-US S&T Forum). The scientific and technological cooperation of India is visible in multidisciplinary areas clean energy, weather forecasting, healthcare, open government data platforms, different sub-domains of physics/chemistry/ life sciences, information technology, nanotechnology, biotechnology, material sciences, engineering, and computer science.

Indo-French Research and Technology Partnership

India and France have a long history of collaboration in Science and Technology. Joint research publications between the two countries have been observed since 1940. The active areas of research cooperation between the two countries are mathematics, physics, chemistry, metrological sciences, and space research. Collaborative research has also been undertaken in the fields of global concerns such as water, infectious diseases, and climate change.

Research partnership thus covers advance scientific areas of research and also areas of developmental concerns reaching out to a wide research community of both the countries. The joint Indo-French papers together account for 2% of India's papers but have 10% presence in India's top 1% cited papers.

Among the important initiatives undertaken by the two countries for the promotion of collaboration is the establishment of a consortium of Indo-French universities. One of the outcomes of this is the facilitation of student mobility between the two countries. It is estimated that 1,300 Indian students study in France. Amongst the other fruitful and long-term partnerships, the two countries are now into space research and civil nuclear cooperation. India and France, to further strengthen the cooperation in these two fields, have signed joint agreements. Collaboration in space research has resulted in joint development of satellites by the two countries for oceanographic studies, studying water cycle, and energy exchange. The Indian Space Research Organisation (ISRO) has launched these satellites. Arain Space of France has also launched geostationary satellites of India. Nuclear cooperation between the two countries has been instrumental in designing the Indian reactor, structural mechanics of nuclear infrastructure, and reactor safety.

The significant influence of French mathematicians on the development of mathematics in India has been observed in at least two topics: algebraic geometry in the 1960s and theoretical partial differential equations in the 1970s.

This engagement has progressed towards more applied areas with weather forecasting emerging as an important area of active research collaboration.

Among the other important initiatives of the Indo–French cooperation has been the establishment of joint laboratories in areas of cutting-edge scientific fields/ areas of global concerns. Some of these laboratories are: Indo–French Cell for Water Sciences, Indo–French Centre for Ground Water Research, and Indo–French Centre for Organic Synthesis. CEFIPRA has played a major role in strengthening these joint laboratories through funding support, organizing seminars/workshops, and other intervention mechanisms.

The Indo-French Chamber of Commerce and Industry (IFCCI) established in 1977, has been playing an important role in strengthening industrial relations between the two countries. The Chamber has members comprising leading French and Indian companies. IFCCI's venture is to provide a stage for facilitating business and networking opportunities between the companies of the two countries, to promote members' interests to key decision-makers and to help develop economic and commercial relations between France and India.

Building Indo–French STI Collaboration

CEFIPRA primarily started as a funding agency for the promotion of scientific research between India and France. There was a strong thrust for promotion of basic research in cutting-edge areas which were highly

promising but had limited funding support. There are a few places across the globe, where research in these areas was undertaken. After nearly fifteen years of its inception, i.e., from 2002 onwards, CEFIPRA expanded its role and transformed itself as a catalyst for strengthening the partnership along with basic research, in applied and industrial research. The organization further increased its horizon of support with the introduction of 'Targeted programme' to provide national agencies of both the countries a platform for collaboration in various areas of research. The Centre has started supporting activities that facilitate knowledge creation through public–private partnership and also helps in exploiting the knowledge for economic and/or social outcomes.

Researchers in academia and industry have been attracted by the support that CEFIPRA has given in STI. Some of the major contributions of CEFIPRA, such as creation of knowledge, addressing different stages of the innovation value chain, and strengthening the STI cooperation between researchers of two countries have been discussed in this section.

Human Resource Development and Capacity Creation

CEFIPRA has played an important role in the development of S&T human resource. The Centre through its funded projects has supported many doctoral and post-doctoral students. The Centre has also been instrumental in supporting over 2,000 exchange visits of the Indian and French scientists

and young researchers. Through these exchange visits CEFIPRA has helped provide students and institutions with opportunities to advance their research in many ways such as benefiting from each other's complementary strengths, access to sophisticated instruments, learning new techniques, and working in cutting-edge research fronts among others. The involvement of researchers from both the countries in research projects has roughly been similar across two countries.

Institutional Linkages and Joint Laboratories

CEFIPRA has played an important role in strengthening linkages between the institutes in both the countries. In India, top performing institutes, in terms of number of projects undertaken through CEFIPRA funding, have been CSIR laboratories, Indian Institute of Technologies, and Indian Institute of Science whereas in France most projects have been funded to CNRS associated laboratories, CNRS laboratories, and universities. Continuity has been observed in terms of involvement of institutes of both the countries in CEFIPRA-funded projects. This can be seen from the number of joint projects undertaken by them spanning over a period of time. This continuity has helped in taking the problem forward, led to significant outputs, and in some cases translation to economic and/or social outcomes. In later years an increase in the number of institutes as well as geographical spread from India linked to French Institutions has also been observed.

Linkages are increasing among the key institutes of both the countries.

Domain specific linkages have been strengthened through CEFIPRA funding. This has created knowledge of significant value in each of the domains. In many cases it has led to the creation of institutional setups such as joint laboratories. In other cases where Indo-French joint laboratories have been in existence, CEFIPRA funding has strengthened those laboratories further. Domain specific linkages are visible in a number of areas such as water, cancer, and infectious diseases. CEFIPRA actively promotes/conducts seminars/workshops in key research areas/sub-areas which also play an important mode for CEFIPRA to identify potential collaborators and invites them to submit joint proposals for funding. Holding them in diverse locations may help this process, further i.e., broadening of CEFIPRA's support mechanism.

Industrial Involvement

CEFIPRA's involvement in funding industrial projects is a small component of its overall funding. However, important initiatives have been taken to strengthen this involvement. Among these initiatives was the floating of a programme "Bridge" projects by an industrial research committee of CEFIPRA in 2001 to ascertain through validation/testing, the feasibility of research ideas at various levels of knowledge generation. Industrial funding supported through CEFIPRA has contributed to promising applications and helped in scaling up the process to a commercial stage. More intensive activity can push this further and henceforth new initiatives by CEFIPRA are in this direction. CEFIPRA has taken

initiatives to finance collaborative research projects involving academic and industrial partners. The goal is to support different phases of innovation value chain.

Developing Scientific Competency

Research publications

Since its inception CEFIPRA has supported over 400 scientific collaborative projects which are classified in 12 Thrust areas: 'pure and applied mathematics', 'computer and information sciences', 'pure and applied chemistry', 'pure and applied physics', 'pure and applied life sciences', 'environmental sciences', 'earth and planetary sciences', 'material sciences', instrumentation, water, biotechnology, and 'technology and information communication'. Till 2012, 333 projects had been completed. From these completed projects more than 2,815 peer-reviewed journal articles/conference proceedings have been produced. CEFIPRA's funding has also nurtured the India–France joint publications. Papers emerging from CEFIPRA-funded projects contribute approximately 17.5% to the collaborative India–France research output. The joint papers also draw attention faster (measured in terms of citations received in the year of paper publication) than India's overall papers.

Research publications are an important reflection of the output of the projects. The value of the papers (primarily this is seen in this study through citations) testifies to the rigorous peer review processes undertaken by CEFIPRA for project funding. Some papers have made

significant global impact, value indication derived from their receiving high degree of citations. Some papers have become very important in creating new areas of cooperation and deeper engagement. For example, a paper on climate chemistry model as an output of a CEFIPRA project "aerosols and Indian monsoons" led to the development of a deeper partnership between Indian and French scientists. A second CEFIPRA project primarily focused on extending this research work. The first author of this paper was a young researcher and had two principal investigators as co-authors. The outcome of this work was the identification of primary particles for weather changes. This work has significantly contributed to a weather forecasting model in India and at the global level.

Although with respect to India's overall papers, the volume of CEFIPRA's output is only a small fraction, but on the other hand it accounts for an average 5% of India's top 1% cited papers.

The Impact Factor (IF) curve exhibits an increasing trend with the average IF jumping from 2.555 in 2001 to 4.0 in 2012. The IF of the most commonly used journals for publishing papers from CEFIPRA funded projects ranges from 2 to 7. Research papers have been published in journals which are leading journals in their respective fields such as *Cell*, *Nature*, *Science*, and *Nature Immunology*. The overall citations have a direct relationship with the increase in number of papers implying that an increase in volume was not comprised with value. The analysis of h-index shows that the overall influence of papers emerging

from CEFIPRA funded projects is increasing (h-index shows that at least these many papers have received citations as indicated by h value).

Developing Technological Competency

Scientific projects apart from scientific publications have also resulted in various forms of technological outputs and outcomes, i.e., development of new algorithms/software's patents, products, process, and designs. Of the overall 333 completed scientific projects, 112 projects (34% of the total completed) have produced 143 processes, 22 products, 24 patents, and 27 designs.

The 12 Thrust areas were discerned in three quartiles: high, medium, and low based on the number of projects completed in each of them. The statistical assessment of technological output shows that within each quartile (high, medium, and low) there is no direct correlation between the technological output and the number of projects. But when an observation is made between the quartiles it can be observed that the high quartile as a group has a higher volume of output followed by medium and low quartiles. For further insight on the efficiency of thrust areas/sub-areas, relationship between the input (per capita expenditure in each thrust area/sub-area of key activities) and output (weighted value of the output measured in terms of technological output, research publications, and human resource) was analysed. 'Material sciences' showed the highest 'rate of return'. 'Life and health sciences', 'pure and applied physics', 'pure and

applied chemistry', and 'computers and information sciences' also showed good 'rate of return'. In sub-fields, it was observed that higher the overall expenditure in a sub-field, greater is the chance of getting higher output.

Around 10 industrial projects were completed till 2012. In comparison to the volume of scientific projects the industrial projects are few but nevertheless they show useful outcomes. Optimizing the production process for Misoprostal, an anti-progesterone drug for fertility control an outcome of CEFIPRA-funded industrial project helped to reduce its production cost. This paved the way for the production of this drug and it is now among one of the major drugs for fertility control. Apart from this industrial projects have led to cost-effective purification strategies for restriction enzymes anti-bodies which is now produced by an SME in India. Industrial projects have also led to the development of new modelling softwares and fabricated materials. CEFIPRA now lays more emphasis on increasing the volume of industrial projects.

New Initiatives and the Path Ahead

CEFIPRA has evolved significantly over the last 25 years. The Centre is now creating new engagements to strengthen the 'research and innovation' ecosystem both the countries. It is trying to create a new compact that provides framework for this new engagement. The academia-industry projects, processes developed in partnership with industry, are some visible outcomes of these new initiatives. The

opening of R&D centres by French industry shows it values STI competency of India and looks towards this as an important location for creating new knowledge that can be exploited for commercial purpose. These R&D centres are acting as a catalyst for this new change in the Indo–French scientific cooperation.

Some of the major new initiatives undertaken by the Centre are:

- It is making efforts to address the whole knowledge value chain, provide a platform for exploiting the knowledge created for social and/or economic goals benefiting both the partner countries. The new logo of CEFIPRA is an expression of this intention.
- CEFIPRA launched a newsletter *Ensemble* in January 2013. This newsletter is helping CEFIPRA to reach out to the stakeholders, providing a forum for showcasing the value of Indo–French partnership in general and CEFIPRA in particular.
- Innovation Program: A new initiative launched to provide a platform for private sector organizations to contribute to Indo–French STI collaboration. The first participant is the Saint Gobain Research India Ltd (SGRI) with whom CEFIPRA will develop a new Innovation Program called “sustainable habitat for hot and/or humid climate”. This would be a five-year programme in which research will be supported for developing sustainable and affordable building material solutions, energy efficient buildings and related topics identified jointly by the two organizations will be covered.
- Saint-Gobain Post-Doctoral Fellowship will be launched in India to fund 2–3 French scientists to support their research in premier Indian institutes in the identified topics with funding mechanism decided jointly by CEFIPRA and Saint-Gobain.
- The Raman-Charpak Fellowship for mobility of doctoral students between the two countries has been recently launched. CEFIPRA is playing the mediating role for facilitating this programme. This fellowship will support bright PhD scholars registered in an Indian or French university to carry out a part of their doctoral research work in France/India. This will give the students exposure to the STI environment of the partnering countries, learn from peers, learn new tools and techniques and strongly encourage them in each funded project.
- CEFIPRA is linking with SMEs in India; exposing them to the opportunities for improving their competence through collaboration with French partners. This will help CEFIPRA to reach out to new stakeholders so that they can play an effective role in exploiting the knowledge-base of both the countries and in the process strengthen the industries of each other.
- Recognizing the scope and benefits of trans-national regional synergy CEFIPRA has started Indo-French Region to Region Cooperation Programme. It intends to provide opportunity to state-level stakeholders in France

and India through the platform provided by CEFIPRA to exploit complimentary capabilities at various stages of the knowledge innovation chain.

- Role of CEFIPRA is being increasingly recognized by other European countries. The India–EU joint house for science and innovation that is being created in India has given high weightage to CEFIPRA institutional model and experience for establishing this institution.
- Indo–French partnership was further strengthened with the recent visit of French President to India and a well-known delegate accompanying him which included French Minister of Higher Education and Research. It has given a push to these new initiatives with many more being launched during his visit. The setting up of a pavilion at Technology Summit 2013 to highlight the success of the Indo–French collaboration and the role CEFIPRA has played in this context is showing how important Indo–French relationship is becoming in STI.

Final Remarks and Strategic Priorities

Observations made from analysing data of different CEFIPRA activities and projects funded by this Centre has given insights which can help it to continue to provide their excellent support towards collaborative projects. The Centre has kept a detailed repository of research reports and other documents. The Centre needs to develop a database that allows for easier access to these

reports. This will help to explore more efficiently the knowledge developed by this institute and capture missing information gaps. If there are recurring reports which highlight the progress of various projects, the reports can be used as a back-up documenting the latest development of the projects, in case the project is abandoned for some reason.

Apart from the progress reports the completion reports must be a necessity for completion of project as this will give an insight into the outcomes of the projects in detail and there must be a prescribed format for the feedback of principal investigators. The analysis of feedbacks should feed into the input process of CEFIPRA funding and monitoring. The institutional linkages between Indo–French institutions can be discerned in a proper manner if the list of French institutes collaborating with India through CEFIPRA is updated annually.

Content analysis from feedbacks by principal investigators of CEFIPRA funded projects highlighted the structural flexibility provided by the Centre for the projects supported by them. Flexibility is in terms of refining or modifying the problem, exploring some aspects in more details or in some other way as the project progresses is cited as the most promising feature of CEFIPRA support. Researchers feel constrained when they cannot explore promising leads as they may not form the submitted proposal. CEFIPRA by allowing this possibility provides attraction to researchers to approach this organisation for support.

Recently CEFIPRA organised a workshop titled “Brainstorming Seminar on CEFIPRA –Beyond 25 Years” with the objective to get feedback

from principal investigators of CEFIPRA funded projects. This workshop has given feedback to the Centre for issues that need to be addressed by CEFIPRA in the journey beyond 25 years. Some of the issues highlighted in the meeting were: the Centre must build a “think tank” consisting of scientists from various fields for periodic feedback to the Centre. It should provide funding to a group of scientists instead of funding to individual scientist by setting up virtual centres. Enhance the interaction of scientists from both the countries for which it can provide French language tutorials to Indian students working in French laboratories to overcome the language and societal barrier. Database creation of Indian students residing in France may help to form some student associations to ensure the necessary support to newcomers. CEFIPRA can also contribute by providing some supporting mechanism to reach out to the vast untapped talent pool of Indian biologists having expertise in the areas of drug discovery, disease model and pharmaceuticals. The areas of intervention can be diabetes, cancer, cardiovascular, metabolic, photonics biology (laser operated medico-surgery) and infectious diseases.

The other major aspects the study feels that CEFIPRA should address include:

- There have been a few seminars held in the field of Science, Technology and Society (STS), but this has not been developed into a particular thrust area by the Centre. The Centre could also concentrate its funding in this field of research.
- Another feature observed is that there is an increasing skewed

pattern in terms of the location of seminars that is more seminars are held in India as compared to France. The seminars could in the future be held in mixed set of locations for the enhancement of STI.

- The “Brainstorming Workshop” held at the Centre in August 2013 and similar sessions in the future would help the Centre to continuously improve its organization and support to the collaborative projects. The workshop concentrated at looking at the Centre’s achievements and a way forward in the area of knowledge creation. It was observed that some projects have applied for patents but either due to lack of funds or other issues have not been able to get patents. A mechanism need to be evolved so that the research outcome can be properly protected.
- The Centre needs to in a proactive manner showcase the outputs and outcomes of projects supported by the centre. The *Ensemble* newsletter is already highlighting the key supported projects and their outcomes. The recent Indo-French technology also highlighted the role of CEFIPRA in strengthening the STI ecosystem of both the countries. The Centre needs to consolidate these highlights periodically and disseminate widely these outcomes.
- In this age of Information Technology the centre must concentrate to a high extent on projects in the field of data analytics. The DST-INRIA agreement

has taken a step in this direction by currently supporting big data, cyber-physical system (including embedded system) & high performance computing. CEFIPRA can use this initiative to strengthen its data analytics programme.

Also as not to lose out on good research projects the centre needs to be flexible for the duration for which the centre's is ready to fund projects. Other issues in terms of environment for the researchers for research in both countries, the centre's could help in organization of support workshops, one being a workshop or course on language training. This was felt to be an important point as for good research correct communication between scientists is highly important.

Strategic Priorities

The study shows CEFIPRA has played an instrumental role in developing collaboration between researchers of the two countries, linking research institutions of the two countries and contributing towards development of skill of young researchers.

Development of research areas are influenced by the funding received by it. A new phase is now visible in which CEFIPRA is trying to address the innovation value chain, enlarging its engagement with a larger number of stakeholder's primarily industrial firms/SMEs of both the countries. The path forward undertaken by CEFIPRA is guided by the commitment of both countries to enhance their science

and technology partnership and give a strong focus to innovation that can help to strengthen the partnership in this domain. The study posits that the following strategies/activities can help to strengthen CEFIPRA further.

Strategic Priority 1

There has been a long and fruitful relationship between India and France and is expanding over the years with collaboration. In research, the collaboration ranges in diverse fields such as space, physical and natural sciences, social sciences, etc., covering the different aspects of the STI value chain. With this expansion, CEFIPRA as a bilateral organization has to address the scope of these new horizons.

Strategic Priority 2

Many CEFIPRA-funded scientific projects have high socio-economic value which can be exploited further through dedicated support of CEFIPRA. CEFIPRA needs to closely re-examine their outcomes and bring in other stakeholders such as industrial partners in this process. There is also a need for benchmarking good practices from the projects and institutionalise them.

Strategic Priority 3

CEFIPRA has taken the initiative to finance industrial projects, and collaborative research projects involving academia and industrial partners, thus trying to address different phases of knowledge innovation chain. This is an important transition which can strengthen the STI

capacity and deliver important socio-economic outcomes.

Strategic Priority 4

With the changing scope of research, the evaluation criteria needs to change. Parameters of evaluation for industrial projects or new initiatives which CEFIPRA is undertaking requires a different evaluation criteria to be put in place which would differ significantly from the scientific funded.

Strategic Priority 5

CEFIPRA actively promotes by conducting seminars and workshops in key research areas or sub-areas. These are also forums for identifying promising researchers of both countries and motivating them to develop joint collaborative projects. Efforts should be undertaken so that these activities also take place in France with same intensity as otherwise it may affect the knowledge exchange, new ideas coming from French scholars and in proper identification of young researchers of France.

Strategic Priority 6

Continuity is observed in terms of involvement of institutes of both the countries in CEFIPRA-funded projects. As output and outcome analysis shows this continuity has helped in taking the problem forward, led to significant outputs and in some cases translation to economic and/or social outcomes. However, the concentration is high

in few institutions that is number of institutes involved in both countries are few. Efforts are required to make the funding more spread out across institutes in both the countries

Strategic Priority 7

The basic structure of functioning in terms of operational flexibility while funding of scientific projects must not be lost. Response from principal investigators highlight that the major motivation behind submitting the joint projects is to access each other's complementary strength. Flexibility in terms of modifying the project objective or methodology is cited as the most promising feature of CEFIPRA support.

Strategic Priority 8

CEFIPRA has taken a number of new initiatives for engaging itself with the different stakeholders that can strengthen the STI of both the countries. Designing a new logo and publishing the newsletter is beginning of this new thinking. Funding Partnership with Saint Gobin to support SME is another important initiative. Working strongly with the proposed EU-India Innovation house, a major partner in the India-France technology summit and organise workshop with SME showing CEFIPRA new thrust. The project recommends that these types of activities should be given high priority.

1

Introduction

International Science, Technology and Innovation Collaboration

Science, Technology and Innovation (STI) have progressed by transcending the boundaries of nations and different cultures with different forms of knowledge exchanges¹. These knowledge exchanges historically have been shaped by informal networks of various kinds. Institutionalisation of these exchanges through mediated actions has helped nations to come together to exploit complementary strength and develop mechanism for targeted actions, pursuit goals that can advance scientific understanding globally, provide new ways to tackle existing problems and create sustainable and inclusive growth². International collaboration in STI thus has a prominent place in the agenda of almost all the countries.

Various factors have motivated this policy agenda of promoting international collaboration. The primary fact that no country is self-sufficient in research, the emerging science requires huge funding, expensive infrastructure and skilled human resource. International collaboration is perceived to address various purposes:

(a) access to and acquisition of leading edge and complementary know-how, (b) access to foreign technology markets, (c) sharing of the costs and risk with international partners, especially when large infrastructures are needed for basic science or product development. Among the other important factors that motivate international collaborations are finding solutions for complex scientific and technical problems that could not be solved with domestic resources alone; access to funds from foreign institutions, access to skilled individuals who might have an interest in pursuing opportunities for research in another country, access to endemic research subjects, such as natural or social phenomena which are limited geographically, and a desire to influence regulatory regimes or standards. It is therefore not surprising that collaborative research has also been identified as contributing to some of the highest impact activity. To put it more precisely, global challenges call for cooperation on a global scale to build capacity in STI at both national and international levels. Fully unlocking this potential requires more effective international cooperation and an appropriate sharing of burdens and benefits in order to protect the global

¹ Luukkonen, T., Tijssen, R. J. W., Persson, O., Silvertsen, G. (1993). The measurement of international scientific collaboration, *Scientometrics*, 28, 15–36.

² OECD (2012). *Education at a Glance 2012: Highlights*. Paris: OECD Publishing.

“commons” and the world’s public goods. Thus one finds international research collaboration is a rapidly growing component of core research activity for all countries.

The scientific world is becoming increasingly interconnected, with international collaboration on the rise. As Wagner (2008)³ puts it, new invisible colleges of science are continuously developing and new global networks which form an open system of learning are emerging through cooperation and various forms of collaborations. One of the indications comes from international collaborations observed in scientific papers; today over 35% of articles published in international journals are internationally collaboration, a positive rise from 25%, 15 years ago.⁴ However, it has not been discerned to what extent they have emerged from informal networks or open systems initiated by individuals and research groups or on account of formal cooperation agreements leading to joint projects or other institutional agreements.

The institutionalisation of the informal networks is increasingly observed, particularly international networks as this formal intervention helps to strengthen the linkages, provide access to resources and enrich the partnership further. The creation of bilateral institution is a step in this direction. This has become more important as social and environmental challenges have increased to an extent of urgency and require global inputs

and actionable programs to tackle them. Climate change, global health, food security, and many other global challenges across national borders affecting large chunk of population deserve the attention of many rather than few individuals⁵. The ambit has broadened to include along with scientific cooperation, the cooperation in technology, and innovation that is STI.

International collaboration takes many forms like research consortia, joint ventures, strategic alliances, and subcontract (Powell and Grodal 2005)⁶. In recent times, organizations emphasise on increasing the multiple ties with individual partner through different strategies. This helps in increasing the points of contacts, which leads to deeper commitment and possibility of higher knowledge sharing. This new approach is driven by the ever increasing complexity of research and realisation that no organisation and country have all the resources to address the present scientific challenges.

There are various factors which enhance the probability of collaboration like development in communication technologies leading to increased mobility of researchers for several purposes like equipment sharing, enhanced quality of research, and increased growth opportunities. Researchers want to work with people who can complement their research and provide new ways for solution. Collaboration has positive impact on

³ Wagner, C. (2008). *The New Invisible College: Science for Development*. Washington DC: Brookings Institution Press.

⁴ Royal Society (2011). *Knowledge, Network and Nations*. UK: Royal Society Publishing.

⁵ OECD (2012). *Education at a Glance 2012: Highlights*. Paris: OECD Publishing, Paris.

⁶ Powell, W. W. and Grodal, S. (2005). *Networks of Innovators*, In: *The Oxford Handbook of Innovation*, Edited by: J. Fagerberg, D. Mowery and R. Nelson. Oxford: Oxford University Press.

the broader objective of science system for addressing specific challenges⁷. These have provided the motivation to different countries for international STI collaboration, and develop specific programs to create formal structures and bilateral arrangements that coordinate and consolidate the international collaboration. A large number of countries are involved with support of various factors such as funding, instruments, and human resource exchange. India has also placed international STI collaboration as a priority in her science and technology program. The section below highlights some of the major initiatives India has taken for strengthening international collaboration in STI.

STI Policy Initiatives of the Government of India

Developing policy mechanism and support structure for international collaboration has been identified as an important factor by the Government of India for strengthening her STI capacity and capability. The basic motive for international collaboration articulated by the Government of India is as follows: “leveraging international expertise, financial resources, access to large scale advanced research facilities and international mega-science projects, cross border training opportunities for (a) strengthening nationally important on-going research programs, (b) accelerating institutional and human capacity building vital to India becoming a global player in knowledge based economy, and

(c) reflecting on global practices relevant to technology and innovation based demands and infrastructural requirements”⁸.

To this end, the Government of India has signed bilateral science and technology agreements with more than sixty countries, which serve a legal and political frame for cooperation. Department of Science and Technology (DST) in India is the nodal department responsible for development and implementation of these agreements. With some countries the international engagement has progressed with more intensity leading to the establishment of bilateral science and technology centres: Indo-French Centre for Promotion of Advanced Research, Indo-German Science and Technology Centre, Indo-Russian Science and Technology Centre and Indo-US Science and Technology Forum.

Joint research papers are perceived as an important evidence of research collaboration. According to a recent study carried by Thomson and Reuters in 2011, 18.8% of Indian research publications in 2001–05 were internationally co-authored, and this increased to 19.5 % in 2006–10. The study further shows that the average citation impact of these internationally co-authored works is significantly higher than the overall average. Figure 1.1 highlights India’s top collaborating partners in research papers.

It shows that USA, Germany, UK, Japan, and France are the top five collaborating countries with India in research papers. India has a long history of collaboration with these five

⁷ Royal Society (2011). *Knowledge, Network and Nations*. UK: Royal Society Publishing.

⁸ For more details please visit <http://www.dst.gov.in>.

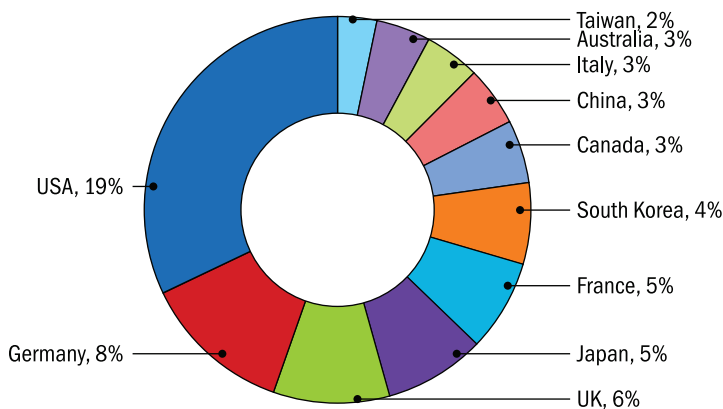


Figure 1.1: India's Top Collaborating Partners in Research Papers (2001–2012)

Source: SCI-E

countries in science and technology. The study primarily examines India's collaboration with France in STI with the specific focus on the role of a bilateral institution. However, to place the study in proper context, India's bilateral science and technology engagements with some major countries are briefly examined.

Indo–French collaboration

France is at the forefront of scientific research and its research organisations continuously produce new and innovative work. Common areas of interest between France and India in scientific research are (but not limited to) chemistry, biotechnology, sustainable development and climate change, health and biology research, nanotechnologies, and space research. India and France have close collaboration in these fields through joint labs, projects, academic exchange visits, joint workshops, and institutional networks. A number of joint structures, projects, and networks between leading scientific research institutes of both the countries have been set up as well.

India and France have traditionally collaborated in fundamental research in the natural sciences, particularly in mathematics, astronomy, physics, chemistry, and life sciences. It has provided numerous platforms for collaboration and interaction in the sciences at the highest levels. Long established and successful scientific partnerships at all levels (from researcher-to-researcher to formal agreements between institutes and joint laboratories) have flourished between the two countries. A joint statement by India and France released this year announced, “an ambitious education plan, including twinning of higher education institutions, mutual recognition of degrees, research collaborations and training of teacher”⁸, thus signifying the promotion and emphasis on scientific and technological research in both countries.

An important outcome of Indo-French collaboration was the establishment of Indo-French Centre for the Promotion of Advanced Research/Centre Franco-Indien pour la Promotion de la Recherche Avancée

(IFCPAR/CEFIPRA) in 1987. This bilateral institution was established to act as a nodal entity to facilitate science and technology collaboration between India and France. CEFIPRA recently completed 25 years of its establishment. In the last 25 years CEFIPRA has evolved and expanded its role from a funding organisation to playing a more proactive role to stimulate the knowledge partnership between the two countries through various modes of action. The organisation is acknowledged as a model institution of bilateral collaboration.

Value of the knowledge created through involvement of CEFIPRA requires closer introspection for further exploiting this knowledge for economic and/or societal gains. The assessment also needs to provide directions for further strengthening the linkages between the organizations of the two countries, identify areas of strength under CEFIPRA and how they can be further exploited, and practices that can be adopted as an institutional framework. This rationale guides this present study.

Previous studies aimed to assess contribution of CEFIPRA, were scientific audit undertaken in 2000, which included a bibliometric study of research papers by CSIR-INSDOC. Further bibliometric studies based on research papers published as an outcome of CEFIPRA supported projects were by CSIR-NISTADS in 2009, and CSIR-NISCAIR in 2010. These studies have shown the contribution of CEFIPRA-funded projects, measured through publication of research papers. They provide an important indication of scientific performance. However, it needs to be kept in perspective that

research papers are only one kind of output and may only provide a partial indication of an organization's STI involvement. Annexure I highlights the salient findings of the three previous assessment studies. The present study attempts to provide a more informed understanding of the role played by CEFIPRA through examining the STI outputs and outcomes. The approach is both qualitative and quantitative and examines various sources to draw attention to the influential role of CEFIPRA.

Objectives

- To investigate the role of CEFIPRA in building and/or strengthening research and innovation competency in the two countries (India and France).
- Delineate intensity and nature of linkages among organisations of two countries that happened through research projects supported by CEFIPRA.
- To discern the various types of outputs that emerged from CEFIPRA supported projects and their scientific or industrial outcomes.

The study further explores contribution of CEFIPRA funded projects towards addressing research challenges, areas of global concerns and providing novel technological solutions.

Methodology

The study is based on extensive analysis of secondary data available from CEFIPRA (Refer Box). Figure 1.2 highlights the major activities undertaken for data organisation and analysis.

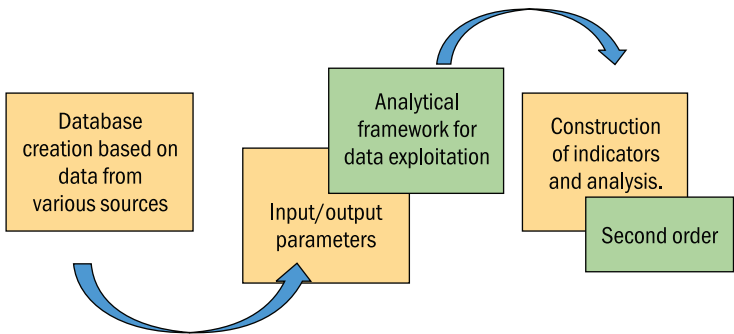


Figure 1.2: Schematic Outline of Data Organisation and Analysis

Note: Indicators were constructed to capture performance based on more than one output or using both input and output. The analysis undertaken from them was designated under “second order analysis”

Major Data Sources

- ✓ Annual Reports of CEFIPRA
- ✓ Ongoing and completed scientific reports
- ✓ Special audit report on bibliometric study by CSIR-NISTADS and CSIR-NISCAIR
- ✓ Minutes of meetings of scientific council and governing body
- ✓ Feedback reports from principal investigators
- ✓ Industrial Projects
- ✓ CEFIPRA bulletin
- ✓ French Science Today newsletters

A qualitative insight was possible for the analysis of the feedback of the primary survey of principal investigators by CEFIPRA of their outputs or outcomes of the project, interactions and experiences with the centre. A few direct interactions with principal investigators were also undertaken. This data was organized in a data matrix containing data of the expenditure per project, human resources involved per project, exchange visits per project, scientific output and inventive and innovative output. Both qualitative and quantitative techniques have

been used to develop a deeper understanding of the CEFIPRA supported STI collaboration.

Basic data organisation such as budget allocated to each activity of the organization was undertaken. For further analysis, thrust areas (major areas in which projects have been granted by CEFIPRA are called thrust areas) were segmented into high, medium, and low quartiles. This classification was done to normalise the size of the thrust area; size defined in terms of number of projects. Detailed classification of thrust areas was done for identifying the key sub-areas of

CEFIPRA funding focus. Linkages between major institute of India and France in major thrust areas or sub-areas were discerned to understand the contribution of CEFIPRA to the Indo-French collaboration.

Human resource and exchange visits in each thrust area were discerned to understand how many researchers are being utilized in projects for the particular thrust area (quartile wise) from both the countries. The major distribution of cities in both India and France in research has been identified to focus on the location-wise distribution of CEFIPRA funded projects. Further, a year-wise analysis of seminars and workshops was undertaken to understand the knowledge sharing platforms provided by CEFIPRA.

A content analysis of the perceptions of the principal scientists was performed based on their feedback inputs. An output of the content analysis was laid out in the form of data matrix which captures the areas of knowledge sharing, strengths, and weaknesses identified by the principal investigators of the CEFIPRA projects. Collaborative projects with the industry was analysed to identify the industrial outcomes, industry-academia link, etc.

Publication profile of Indo-French joint publications and emerging from CEFIPRA-funded projects were analysed through Science Citation Index - Expanded (SCI-E) database to discern the collaboration research dynamics. Indicators such as average citation, highly cited papers, and average impact factor were applied to assess the value of the research output.

The study has constructed various indicators from budget,

publication, technological outputs to capture the project performance of CEFIPRA-funded projects. Further indicators were constructed to capture performance based on more than one output or using both input and output. The analysis undertaken from them was designated under “second order analysis”. The first composite index constructed was called “technology output index”. This index helped to assess the volume of inventive and innovative output produced in each thrust area. The innovative and inventive outputs are discerned under process, product, patent, design, and instruments with the help of discipline experts (Refer Annexure II for details on construction of technology output index).

The second composite index designated as “volume–value index” was based on the inter-relationships between input variable (designated as volume) and output variable (designated as value). Input variable was based on total expenditure (thrust area-wise), and output variable was a composite index of research publications, technological outputs, and human resource developed (thrust area wise). This index helped to judge the relative performance of a particular thrust area (Refer Annexure II for details on construction of volume–value index).

India— International STI Collaboration

India-USA Collaboration

It dates back to 1950's when an agricultural research was set up with support from USA PL480 funds. Further, Indo-US collaborations spread

to other fields like establishment of Indian Institute of Technology, Kanpur and National Council of Education, Research and Training (NCERT) Delhi, and agricultural universities.

India- UK Collaboration

It was further strengthened in 1996 with the signing of the Science and Technology Agreement. A joint declaration was made in 2004 which paved a way for a new and dynamic partnership backed by annual summits and regular meetings between foreign ministers. In 2006, '*Science and Innovation Council*', was set up which forms the base for bilateral cooperation. Some of the areas outlined for future cooperation are civil nuclear energy, space, defence, combating terrorism, economic ties, science & technology, education and culture.

India-Germany Collaboration

Two inter-governmental agreements were initiated in 1971 and 1974. Many special pacts have been signed between German and Indian research organizations, which cover under its umbrella the implementation of common research projects as well as exchange of scientists.

India- Japan Collaboration

In 1992, a meeting of the Japan Society for the Promotion of Science (JSPS) and Indian S&T delegation resulted in joint projects. Major areas of collaborative research are molecular structure, spectroscopy & dynamics; advanced materials including nano-materials; modern biology and biotechnology including biomedical science; manufacturing sciences; space

science; surface and interface sciences including catalysis.

India-China Collaboration

In 1988, an agreement for cooperation in S&T between the two countries was formalized. Now and then, joint R&D projects, joint workshops and exploratory visits are carried out between the two countries. Many agreements and MoU in areas – 'metrology, standards and quality', 'bilateral science museum programmes, civil aeronautics, health and medicine have been signed. The China Academy of Space Technology proposed a joint collaboration for a space solar power mission with India in 2012.

Chapter Outline

The report is divided into five chapters including this Chapter. The brief of the chapters are as highlighted below.

Chapter 2 – CEFIPRA: Strengthening scientific, technological and innovation cooperation between India and France

This chapter gives a comparative snapshot of Indo-French innovation landscape. The genesis and evolution of CEFIPRA, its role in strengthening the scientific, technological, and innovation research between the two countries is explored. Structural and functional changes that have come over the years and sub-areas in which projects were funded are highlighted.

Chapter 3 – CEFIPRA: Human resource and capacity creation

The chapter discusses the involvement of CEFIPRA in development of human

resource in India and France. It examines research support given to young scholars, and exchange visits, seminars, or workshops for knowledge sharing. This chapter also analyses the feedback provided by the principal investigators. This provides insight to how the project funding has benefited the institution or research group in taking forward their research activities in various fields and contributed to overall capacity creation.

Chapter 4 – CEFIPRA: Outputs and outcomes

Chapter 4 attempts to capture the scientific and innovation outputs

from various activities supported by the CEFIPRA. Detailed analysis of the publications (scientific output) and technological outputs (products, patents, processes, instruments, and designs) emerging from supported research projects is highlighted.

Chapter 5 – Discussion, conclusion and strategic priorities

Chapter 5 discusses the key findings of this study, brings together the lesson learnt and concluding remarks. Finally, it states the strategic priorities that can strengthen CEFIPRA's intervention in the Indo-French knowledge value chain.



CEFIPRA: Strengthening Scientific, Technological, and Innovation Cooperation between India and France

Science, Technology, and Innovation Cooperation between India and France

France is one among the highly advanced countries in science and technology. It has played a pivotal role in advancing scientific knowledge globally, and exploiting that knowledge for social and/or economic impact. India on the other hand is one of the leading countries amongst emerging economies in science and technology. Among the commonality between the two countries is the existence of a vast network of scientific institutions, universities, a culture of scientific research, and state giving high value to the promotion of scientific research.

Laboratory to market that is “translational research”, sustainable technology development, mitigating global concerns in environment, and healthcare are challenges for both the countries and the world at large. The key issue that is emerging globally in countries actively involved in research and development is to create an “innovation ecosystem” that can exploit scientific and technological strength which would lead towards economic and social partnership between academia-industry and create translational Science, Technology and Innovation (STI) linkages. This is

giving a new shape to the India–France cooperation partnership. There is now a strong desire to create an enabling environment which strengthens STI of both the countries and the ability to translate the knowledge more towards creating social and economic outcomes. STI policy recently articulated by India aims for strategic partnerships and alliances with other nations through both bilateral and multilateral cooperation in STI.¹ Falling into these lines is the Indo–French STI bilateral cooperation, as Francois Richer, French Ambassador to India puts it, “A new phase for defence and energy has developed between India and France, which is expected to trigger an enormous industrial and technological partnership between both the countries. In this partnership, innovation has major role to play”.¹ Figure 2.1 highlights the salient aspects of India and France policy initiative towards developing innovation ecosystem.

One can observe that both the countries have given a strong push for developing “research and innovation ecosystem”. A striking difference that one can observe is the funding pattern for research and development; in India almost 75% of the funding comes from government whereas in France the research funding pattern resembles that of other advanced Organisation

¹ *Ensemble*: Vol. 1(1). January, 2013.

French Innovation Policy Landscape		Indian Innovation Policy Landscape	
1999 Innovation and Research Act 2003 French Innovation Plan	• Focused on technology transfer from public research to private firms; Public Private Partnerships; Research grants and funding and incentivising innovative firms	2003 Promotion of innovation	• Science becoming increasingly inter- and multi-disciplinary with participation of many institutions and countries. • The Government of India discussed 'Promotion of Innovation' with a plan of comprehensive national system of innovation.
2005	• Research Bill for collaboration between public labs and industries passed, Agence de l'Innovation Industrielle established.	2008 The Draft National Innovation Act	• To facilitate public, private, or public-private partnership to encourage innovation. • Evolve a National Integrated Science and Technology Plan and codify and consolidate the law of confidentiality in to protect confidential information, trade secrets and innovation.
2006 Pact on research	• Highest share of R&D Spent, 2.12% of GDP, business firms (1.32%), higher education (0.40%), the government (0.37%).	2013 STI policy	• Major functions: supply incentives and resources for institutes and companies to engage in innovative work and provide legitimacy for the innovation.
2007 Law on university areas of freedom and responsibility	• Greater autonomy and funding of research universities. Higher education and research in 2007 ranks 4th in terms of budget allocation with Euro 21.28 billion.	Twelfth Five-Year Plan	• Formation of the National Innovation Council and declaration of 2011–20 as a 'Decade of Innovations'. • Roadmap for Innovations for the next decade by focusing: Platform, Inclusion, Eco-system, Drivers and Discourse.
2009 Adopted National Research and Innovation Strategy	• Meet challenges with research in focus, re-establish dialogue between science and society. It also focuses on transformation of research to innovation by bridging the market and societal needs.		

Figure 2.1: Innovation policy landscape of India and France

for Economic Cooperation and Development (OECD) countries.

IFCPAR/CEFIPRA: Establishment and Evolution

One of the successful outcomes of the Indo–French Science and Technology cooperation has been the establishment of IFCPAR/CEFIPRA in 1987.

Its establishment was a successful outcome of the bilateral engagement of India and France during a meeting of Late Indian Prime Minister Mrs Indira Gandhi and the (then) President of France Monsieur Giscard D' Estating. They felt the need to create a new institution which would embody the spirit of science and technology cooperation between the two countries and bring together the best intellects from both nations to find solutions for various issues and challenges faced by their citizens.

After a series of meetings, the formal decision to set up the centre was taken between the Foreign Secretary of India

and Sécretaire Général of the French Ministry of Foreign Affairs in 1985. CEFIPRA was then jointly established in September 1987 by the Department of Science and Technology, Government of India and the Ministry of Foreign Affairs, Government of France.

The following major objectives have guided the centre in pursuing its mandate over the years:

- Promotion of cooperation in advanced areas of fundamental and applied scientific research between India and France.
- Development of cooperation through identification of scientists and scientific institutions of the two countries likely to cooperate in a profitable way.
- Provision of assistance in the form of grants and equipment as well as other appropriate means of support for pursuing advanced research.
- Organisation of workshops or seminars and other types of activities on topics of mutual interest.

- Promotion of applied or industrial research projects through collaboration between educational and research institutions and industry.

The evolution of CEFIPRA, from its beginning as an institution devoted to catalysing research and knowledge exchange, to an organization contributing to every aspect of the knowledge chain was made possible by the active support of both the governments, the scientific communities of both the countries and all those who have been associated with CEFIPRA over the years that have gone by.

Initially, the scientific council of CEFIPRA interacted with all stakeholders to get an overview of the ongoing science and technology collaborations at the time between India and France and consolidated such programmes under CEFIPRA. A structured system was developed for receiving proposals from scientists, formulating the evaluation criteria, and devising outreach mechanisms by conducting council meetings. Seminars and workshops were conducted in emerging areas, to encourage good collaborative research proposals.

The primary objective of supporting collaborative research projects is to complement the expertise and strength of high quality research groups in advanced areas of science and technology between both the countries, thereby promoting excellence in science. Over the years the Centre has broadened its role by helping develop human resource, funding projects resulting in research papers of global impact, new industrial products or processes that were

transferred to industries in both the countries, and facilitated the creation of new centres of competence between the two countries apart from many other important initiatives.

The scientific project funding also expanded its scope in terms of research domains and sub-domains that were covered. Figure 2.2 highlights ongoing scientific projects in different areas of research over the years providing an indication of the changing trend of scientific research projects.

Nearly after 15 years of its inception, CEFIPRA added the programme of academia–industry linkages in the project mode. Since this had called for a different kind of expertise CEFIPRA's governing body constituted a separate committee to look into this programme. Now more than ten years old, the programme already possesses several success stories to narrate with few major products in the market. It can be observed that since 2011, CEFIPRA is concentrating on addressing the whole knowledge value chain and strongly stressing on innovation and addressing global challenges. Figure 2.3 gives a stylized version of the three phases of CEFIPRA.

In its first phase, CEFIPRA primarily supported projects of basic research in mathematics, life, and health sciences, pure and applied physics, and chemistry. It is pertinent to mention here that the basic research proposals funded by the centre so far are of high significance considering their social, technical and industrial relevance. For instance, the high impact scientific research projects funded by CEFIPRA include solution for mitigating arsenic contamination in water, protein trafficking, hydrogels, and novel

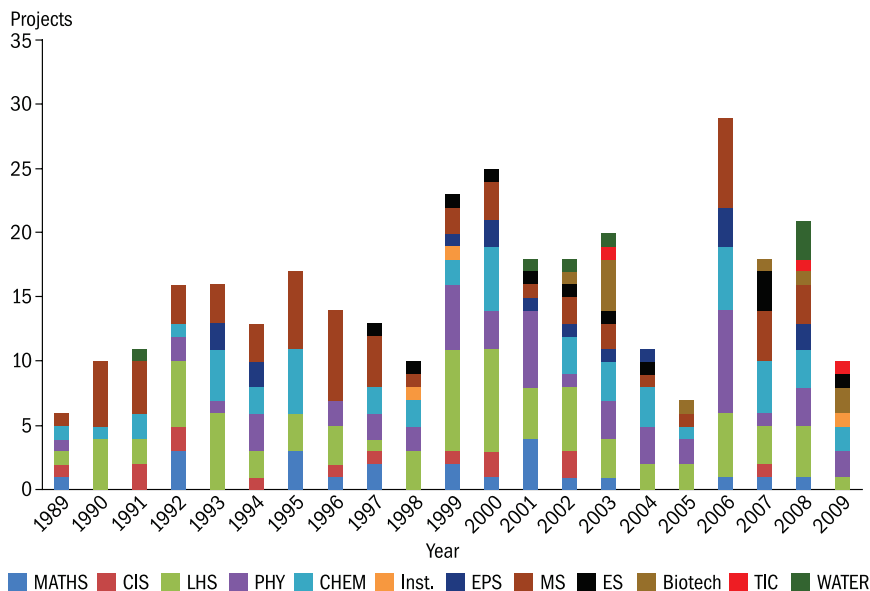


Figure 2.2: Ongoing CEFIPRA Scientific Projects (1989–2009)
Source: CEFIPRA Annual Reports

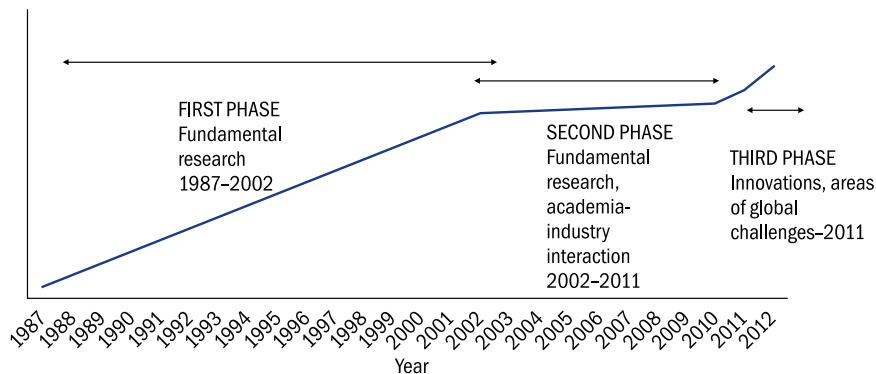


Figure 2.3: Phases of Evolution of CEFIPRA
Source: Constructed by authors based on discussion with CEFIPRA

hydrophobically modified polymers. Industrial research projects have also led to important outcomes. The report highlights these in details.

Completion of 25 years of CEFIPRA and the dynamism of Indo–French partnership has motivated this

institution to address every aspect of the knowledge value chain; promoting targeted programs aimed at enabling other agencies from France and India to utilize the platform of CEFIPRA to foster collaborations in specific theme areas and domains.² The Centre is engaging

² *Ensemble*: Vol. 1(1). January, 2013.

with SMEs (small and medium enterprises) of both the countries, and exploring new avenues for exploiting the knowledge it has helped to create. These activities will drive the “third phase” of CEFIPRA.

India, France and STI Bilateral Cooperation

India and France have a long collaborative relationship in various fields of research. Space research, mathematics, condensed matter physics, and infectious diseases are some of the areas where there is an active research engagement between various research groups of the two countries.

The establishment of IFCPAR/ CEFIPRA is one important outcome. The report focuses on its role, the value

of the knowledge which has been created through funding scientific and industrial research projects, outreach programmes, etc., influencing the overall STI programmes.

Among the other important initiatives of the Indo–French cooperation has been the establishment of joint laboratories in areas of cutting-edge scientific fields and areas of global concerns. Some of the establishment of the laboratories can be traced to the partnerships that started from CEFIPRA funding support. All these joint laboratories have some linkages with CEFIPRA. Table 2.1 highlights the salient aspects of Indo–French joint laboratories.

It can be observed that the research partnership covers advance scientific areas of research and also areas of developmental concerns.

Table 2.1: India and France Cooperation — Joint Laboratories		
Laboratory Name	Collaborating Institutes	Area of Collaboration
Indo–French Cell for Water Sciences	Indian Institute of Science — IRD	Water
Indo–French Centre for Ground Water Research	CSIR-National Geophysical Research Institute — BRGM	Water
Neurosciences Protect	National Brain Research Centre — INSERM	Neurosciences
Indo–French Associated Lab for Nuclear Sciences	Bhabha Atomic Research Centre - CEA - CNRS	Nuclear Sciences
IJL	NIIMH–INSERM–UPMC	Immuno–haematology
Joint Laboratory for Sustainable Chemistry at Interfaces	CSIR-Indian Institute of Chemical Technology–CNRS–University of Rennes	Chemistry
IJL	CSIR- National Chemical Laboratory– CNRS -University of Lille	Chemistry
Joint laboratory in Solid State Structural Chemistry	Indian Institute of Science – Crismat – CNRS – University of Bordeaux	Chemistry
Indo–French Centre for Applied Mathematics	Indian Institute of Science and others — CNRS	Mathematics

The total scientific papers from Indo–French collaboration research have increased 8.8 times during the study period that is from 31 papers in 1990 to 275 papers in 2009. The contribution from CEFIPRA has also increased during the period. CEFIPRA contributions to scientific papers have increased by 482% during the period that is from 11 papers in 1990 to 64 papers in 1999 which is about 59.5% of the total collaboration output (see Table 2.2).

The total collaboration output between India and France has increased 141% from 114 papers in 2000 to 275 papers in 2009. CEFIPRA contributions to scientific research papers increased 80% during the period that is from 45 papers in 2000 to 81 papers in 2009, which is about 34% of the total collaboration output from 2000 to 2009 (see Table 2.2). The percentage contribution from CEFIPRA to the total collaboration papers was highest in 1994 that is, 84%. Figure 2.4 shows the CEFIPRA's

Table 2.2: Indo–French Collaboration Research and Contribution of CEFIPRA 1990–2009

Year	Total papers	CEFIPRA papers	% Increase from 1990		% Contribution
			Total	CEFIPRA	
1990	31	11	0	0	35.48
1991	53	12	71	9	22.64
1992	50	35	61	218	70.00
1993	67	55	116	400	82.09
1994	67	57	116	418	85.07
1995	84	56	171	409	66.67
1996	121	72	290	555	59.50
1997	108	58	248	427	53.70
1998	136	73	339	564	53.68
1999	111	64	258	482	57.66
Total	828	493			59.54
2000	114	45	0	0	39.47
2001	137	39	20	13	28.47
2002	158	78	39	73	49.37
2003	174	62	53	38	35.63
2004	155	71	36	58	45.81
2005	182	76	60	69	41.76
2006	256	69	125	53	26.95
2007	253	81	122	80	32.02
2008	282	74	147	64	26.24
2009	275	81	141	80	29.45
Total	1986	676			34.04

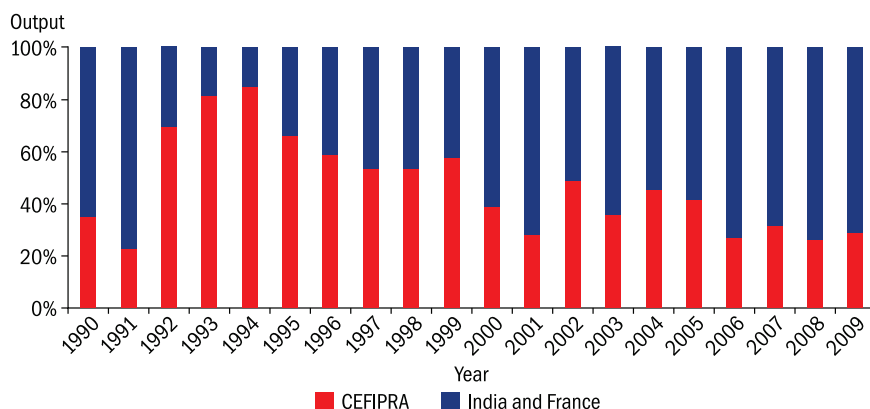


Figure 2.4: CEFIPRA's contribution to the collaboration research of India and France 1990–2009

contribution to the collaboration scientific research output of India and France from 1990 to 2009. CEFIPRA's contribution was almost 85 % of the total collaboration output in 1994.

Another important initiative is the establishment of consortium of Indo–French universities to increase educational cooperation. One of the outcomes of this is the facilitation provided for mobility of students between the two countries. It is estimated that 1,300 Indian students study in France. India and France have also signed a joint cooperation on space research and technology. This resulted in the Megha–Tropiques mission wherein a meteorological research satellite jointly developed by Indian Space Research Organisation (ISRO) and France Centre National d'Etudes Spatiales (CNES) was placed in orbit by ISRO's Polar Satellite Launch Vehicle (PSLV-C18) in 2011. In 2012, India launched a French satellite Spot-6 through the PSLV. Similarly in

2013, ISRO launched SARAL, an Indo–French satellite jointly developed by ISRO and CNES.

The influence of French mathematicians on the development of mathematics in India has played a leading role in at least two topics: algebraic geometry in the 1960s and theoretical partial differential equations in the 1970s. While J L Lions was at the head of Institut National de Recherche en Informatique et Automatique (INRIA) in Rocquencourt, he developed close relations with several Indian institutions such as Indian Institute of Science (IISc) in Bangalore, Indian Institute of Technology (IIT) in Delhi, and most of all with the small group of mathematicians working on partial differential equations in the Bangalore section of Tata Institute of Fundamental Research (TIFR). In September 1997, Master of Scientific Calculus was started by the University of Pondicherry.³ This partnership has been carried

³ Waldschmidt, M. (2010). Indo-French Cooperation in Mathematics. *Special Issue on Mathematics Newsletter*, 19(1), pp. 1–12.

Major funding institutions for Indo–French collaboration research include:

- ✓ Council of Scientific and Industrial Research (CSIR), India
- ✓ Centre National de la Recherche Scientifique (CNRS), France
- ✓ University Grants Commission (UGC), India
- ✓ French Embassy, New Delhi, India
- ✓ Department of Biotechnology (DBT), India
- ✓ Bill and Melinda Gates Foundation
- ✓ French Ministry of Research, France
- ✓ French Ministry for Foreign Affairs, France
- ✓ Anr agence nationale de la recherche, France
- ✓ National Institute of Immunology (NII), India

forward in various domains of this field. A significant achievement has been observed in weather forecasting which is a result of a joint collaboration between the researchers from both the countries. CEFIPRA has played a key role in strengthening various partnerships.

In addition, India and France cooperation has led to new initiatives in various disciplines. For example, the Delhi Technological University (DTU) signed an MoU with a network of seven institutions in France to foster collaboration and create opportunities in engineering. Under this MoU scholars from both the countries will undertake exchange visits to explore the mutual areas of cooperation. The department of physics and astrophysics, University of Delhi (DU) will be collaborating with seven French institutes to offer a dual degree programme in nuclear science.⁴ Institute Curie, Paris and National Centre for Biological Sciences

(NCBS), Bangalore signed a joint agreement on collaborative research.⁵ One of the promising developments is the industry–academia partnership involving industrial partners and research institutions of both the countries.

Furthering the Indo–French collaboration is the Indo–French networking research programme. Through this programme network projects are supported in priority areas such as environmental sciences (including water resources, climate change, water treatment, management, and quality), organic chemistry (including synthesis of bioactive molecules); physics (lasers); information technology; and bio-informatics in relation to health and to agronomy.⁶ One can observe well- defined mission statements or objectives for ensuring that these programmes will strengthen the partnership in each domain.

⁴ Indo-French Science and Technology News. (November, 2009). *Journal of the Science*, Department of the French Embassy in India. New Delhi.

⁵ Indo-French Science and Technology News. (November, 2009). *Journal of the Science*, Department of the French Embassy in India. New Delhi.

⁶ DST Annual Report 2004-05. Retrieved July 5, 2013, from http://www.dst.gov.in/about_us/ar04-05s-tcoop.htm

The following objectives guide the Indo–French water network:

- To link all the French actors (scientists or researchers) working in India as well as their partners and other Indian actors so that there is a better understanding of each other's activities.
- To promote the development of collaborations of all kinds between French and Indian actors.
- To promote research projects which are interdisciplinary or multidisciplinary.
- To support the transfer of innovative and practical solutions from research to targeted audiences.
- To ensure the visibility of the concerned actors and their current actions which are not well known.⁷ CEFIPRA plays an active role in supporting projects and creating platform for strengthening these network programmes.

India–France Industry Relations

Fostering science-business links and commercialising research results have been an essential component of research and innovation policy agenda for more than a decade in many countries. Increased attention is being paid to prioritize funding in mission-driven research and innovation. India is observing 2010–20 as the “decade of innovation”; the focus has embarked on prioritizing innovation-based groups and public–private partnerships in

all key spheres of the economy. The programmes at cluster innovation centres foster innovation, facilitate collaborations with industry, academia, and other sections of the society and encourage bringing out solutions for real life problems.

Indo–French Chamber of Commerce and Industry (IFCCI)⁸ established in 1977 is now a bilateral business organization with 500 active members of French and Indian companies from

French companies are increasingly interested in setting up their innovation centres in India. To do so, they have to deal with various issues from cultural differences to property, which has led to a need to meet and share ideas around research and development and innovation. Hence, the Ministry of Science and Technology, Government of India along with the Economic Department of the French Embassy, has created the “Club R&D India”. The first meeting was held at the Residence de France, Delhi on June 13, 2012. Around 13 French companies were present from various sectors (such as cosmetics and solar systems) whose managers were invited to share experiences, good practices, issues, advices, or success stories.⁹

⁷ Retrieved July 5, 2013, from www.frenchsciencetoday.org

⁸ Retrieved July 8, 2013, from <http://www.ifcci.org.in/>

⁹ *Indo–French Science and Technology News*, September 2012.

a variety of sectors. IFCCI is mutually beneficial relation between India and France through channels of trade and industry. The chamber has members comprising leading French and Indian companies. IFCCI's venture is to provide a stage for facilitating business and networking opportunities between companies of two countries, to promote members' interests to key decision-makers and to help develop economic and commercial relations between France and India.

In 1998, a protocol of intent was signed between the Ministry of Industry, Government of India, and the Ministry of Economy, Finance and Industry, Government of France. The idea was to make joint efforts to promote greater industrial and technological cooperation between two countries through investments in industrial and technological sectors. This includes encouraging a constant exchange of information and individual contacts between companies via seminars, meetings, and other joint ventures in priority sectors.

The Innovation and Research Act in 2009 and National Research and Innovation Strategy (SNRI) adopted by France were mainly aimed at modernizing and reorganizing the French innovation system. In India too, innovation is emerging as the key strategy for exploiting the science and technology strength of the country. Government's articulation of 2011–20 as the decade of innovation, the creation of National Innovation Council, and the Science Technology and Innovation Policy 2013 are among the major steps undertaken by the government in this regard. The government's new approach can be

seen from the policy document of 2013 that states that "the national science and technology enterprise must now embrace science and technology led innovation as a driver for development.

France and India have developed various STI strategies at different levels. Recently, a MoU has been signed in February 2013 between the Ministry of Railways, Government of India and the Société Nationale des Chemins de Fer Français (SNCF), the French National Railways, for technical cooperation in the field of railways. Furthermore, French Trade Commission UBIFRANCE in India promotes trade relations between France and India and assists French-based companies seeking potential partners and new markets in India. It helps Indian businesses to identify potential French suppliers and technical partners.

Many new initiatives have been taken by India and France to broaden and strengthen human resource and innovation capacity. Some of their new initiatives are:

- To foster comprehensive sustainable urban development cooperation, including infrastructure, transport, water, waste management as well as urban planning.
- To foster people mobility between both the countries. To that end, both sides noted the progress in the negotiations of a bilateral agreement on people's mobility and migration, with a view to conclude them as soon as possible.
- To build an ambitious education plan, including twinning of higher education institutions, mutual recognition of degrees, research collaborations, and training of

teachers. A letter of intent and several agreements between Indian and French universities and institutions have been signed in this regard.¹⁰

Project Approval Process of CEFIPRA

In search of excellence in STI collaboration, CEFIPRA has devised a mechanism of highly competitive project formulation criteria. Figure 2.5 lists the criteria of project formulation of CEFIPRA projects.

One important requirement that can be observed for getting support is involving the researchers from both the countries in the project. Also the choice of topic has to be contemporary. This institutional mechanism ensures involvement of researchers of both the countries and addressing scientific problems which are of current relevance. This helps in addressing the major objective of CEFIPRA that is to develop a suitable framework through project funding that enable interactions between the active groups of the two countries. Another important decision by the scientific council of CEFIPRA has been to ensure that each project supported by CEFIPRA has allocation

for doctoral and post-doctoral positions in the relevant fields. The importance attached to human resource development through the programmes of the Centre has been a central tenant of its involvement.

CEFIPRA has an intensive process for deciding the funding and has a mechanism for continuous project monitoring after the decision for funding a project is taken. The feedback from principal investigators has shown that this monitoring mechanism is extremely useful for the successful completion of a project. Figure 2.6 gives a detailed process flow for CEFIPRA/IFCPAR funding.

Thus one can observe that project proposals undergo a system of intensive peer review by experts in India and France before being considered by the council. Also it is important to note that all projects go through a process of clearance from both the governments before being implemented and financially supported.

Four kinds of operational modalities are now possible under the following categories: (a) blue sky, (b) innovation, (c) targeted programmes, and (d) support to new initiatives.

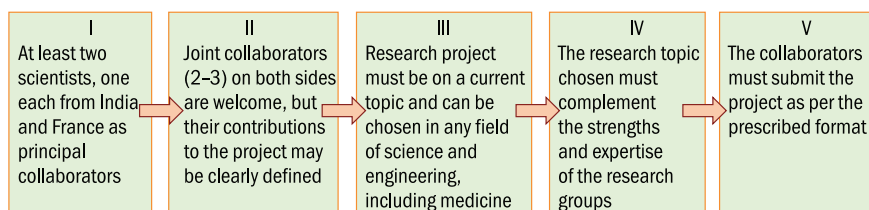


Figure 2.5: Project Formulation Criteria

Source: cefipra.org

¹⁰ *Ensemble*: Vol. 1 (2), March 2013.

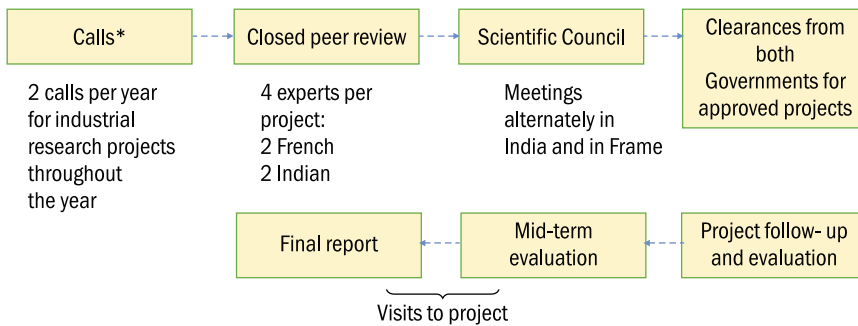


Figure 2.6: Process Flow for IFCPAR/CEFIPRA Funding

*Refer Figure 2.5 for details of criteria for project submission.

Source: Constructed based on presentation of Dr A Amudeswari (former Director, IFCPAR/ CEFIPRA)¹¹

The “CEFIPRA blue sky” is undertaken to look after the procedural activities of the centre. In this the centre will fund seminars and research projects in the area of science and technology, supported and evaluated by both the governments. “CEFIPRA innovation” will link the industry and academia for research projects. For the new research collaboration a rigorous selection procedure for selection of partners will be carried out. The “CEFIPRA targeted programmes” will help administer the projects and/or seminars of the collaborating partner organizations of both the countries. The “CEFIPRA support to other initiatives” would help the partner organizations to build a network of organizations in key scientific research with the support of CEFIPRA. It will also provide for the partners to establish a research network of organizations for knowledge building and sharing.¹² Figure 2.7 broadly highlights the overall activity and outcome of CEFIPRA. The

subsequent analysis examines each of the activities in details.

“The interest of IFCPAR/CEFIPRA is to create a very good environment to produce excellent collaboration as young scientists can visit the partner lab as senior ones. I was quite surprised by the travel of young scientists, implicated in our IFCPAR/CEFIPRA project, were so efficient and how they have improved the quality of our researches. They have raised new questions and also proposed new experimental design.”

Alexandre G.de Brevern,
Researcher, INSERM UMR-S,
University Paris Diderot-Paris 7,
(DSIMB), Paris

¹¹ Website link: http://eeas.europa.eu/delegations/india/documents/eu_india/023_03_presentation_amudeswari_en.pdf

¹² Retrieved July 5, 2013 from http://eeas.europa.eu/delegations/india/documents/snt_update_26_oct_12/10_presentations/france.pdf/

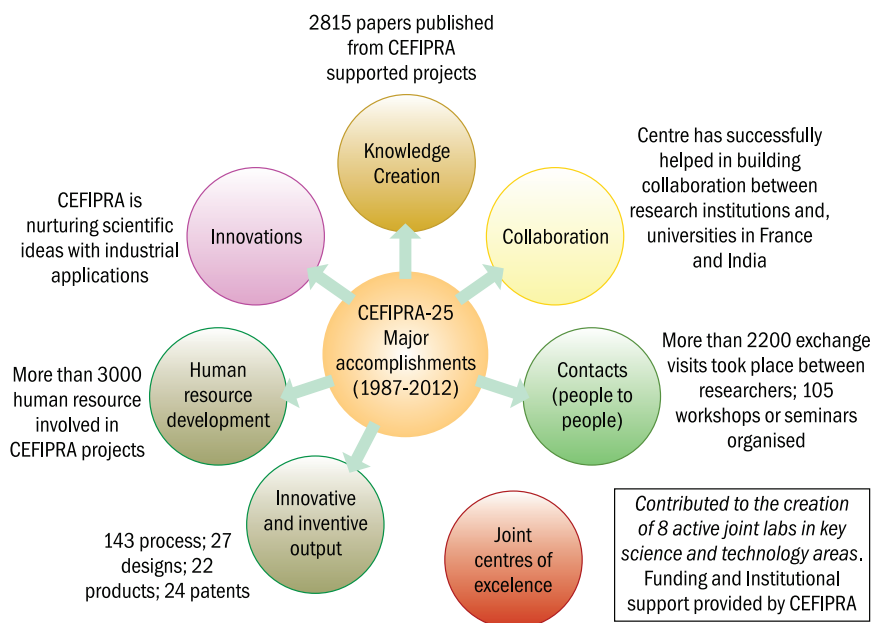


Figure 2.7: Activities of CEFIPRA
Source: Constructed from Various CEFIPRA Documents

Overview of Collaborative Research Projects Funded by CEFIPRA

CEFIPRA plays an important role in developing and strengthening collaboration between India and France by acting as a fulcrum. Collaborative research projects funded by CEFIPRA are essentially complementing the core strengths of the individual scientists or research group in cutting-edge science and technology areas. Till 2012, the centre recommended a total 451 projects from different thrust areas of STI for financial support out of which 333 have been completed. CEFIPRA considers projects from different thrust areas that include areas of cutting-edge scientific research and also

projects of high social, environmental, and health significance. In the years 1999 and 2000 eight projects were started in the thrust area of “life and health sciences”. In the year 2002, projects funded also started in the field of “biotechnology” and in the year 2003 funding for projects in the thrust area of “technology for information and communication” was also started. Further in the year 2008, eight projects were started in the field of “physics”. Figure 2.8 shows the trend of completed scientific projects in respective years under CEFIPRA.

CEFIPRA funds scientific projects under 12 thrust areas. The study is based on the 333 completed scientific projects. For analysis we have distinguished the projects in three quartiles as high, medium, and low based on the number

of projects completed as given in Table 2.3 (please note that high, medium, and Low are not in terms of significance of the project or thrust area).

From Table 2.3, it is apparent that the maximum number of projects was funded in 'life and health sciences' followed by 'material sciences'.

High Quartile Thrust Area

The maximum number of projects is funded in molecular biology (17 projects). The active sub-areas include genetic engineering, membrane biology, and study of protein interactions (Figure 2.9). In immunology, research

Table 2.3: Quartile-wise Distribution of Thrust Areas	
High quartile	Projects
Life and Health Sciences	75
Pure and Applied Chemistry	52
Pure and Applied Physics	51
Material Sciences	69
Medium quartile	Projects
Biotechnology	8
Water	8
Environmental Sciences	12
Earth and Planetary Sciences	15
Pure and Applied Mathematics	22
Computers and Information Sciences	14
Low quartile	Projects
Technology for Information and Communication	4
Instrumentation	3

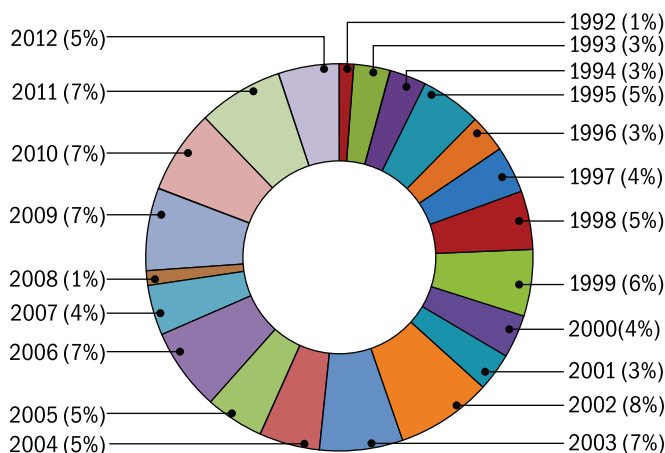


Figure 2.8: Year-wise distribution of completed projects

on various infectious diseases such as rabies, malaria, hepatitis, tuberculosis, and fungal infections in plant have been conducted. Research on cancer is another active area where CEFIPRA funding can be observed. Under this, research has been done on different types of cancer such as leukaemia, cervical cancer, and breast cancer. Apart from this some of the other areas of funding are mycology, neurology, enzymology, virology, and systems biology.

The area of major focus is 'condensed matter physics' (21 projects) (Figure 2.9) which includes sub-areas like intermetallic alloys, superconductors, nanostructure and nanomaterial, water, magneto optics, and thin films. Apart from this other major areas are polymer chemistry, opto-electronics and glass transition.

Medium Quartile Thrust Area

Pure and Applied Mathematics: Areas of joint research have been in abstract algebra, number theory, probability problems, differential geometry, and numerical methods. CEFIPRA has also funded applied research in this domain such as computational simulation, weather forecasting.

Earth and Planetary Sciences:
The areas of funding have been in analytical signals, satellite gravity, weather forecasting, ocean forecasting, telecommunications, earthquake frequency measures, and remote sensing.

Water: Research where focus is on increasing cost efficiency of water treatment procedures such as arsenic removal, metallic minerals, and other kind of water pollutants

Budget Analysis

The expenditure details for the period 1989–2012 has been highlighted in Figures 2.10 and 2.12.

Figure 2.12 shows the share of expenditure under various heads. The share of running expenditure seems to be almost constant from the figure.

Under project expenses the expenditure related to projects under various thrust areas in absolute terms and normalized by number of projects (Total expenditure in a Thrust area/ Number of projects in a Thrust area). Expenditure per project provides a more realistic estimate.

It can be clearly seen that there is no major difference when we normalize the budget in each thrust area with

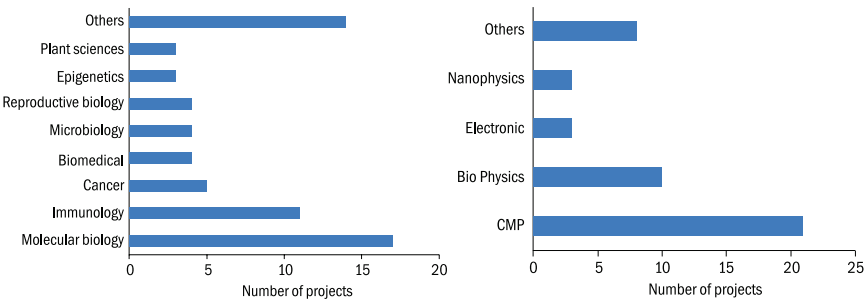


Figure 2.9: Number of projects funded sub-area wise in the field of LHS and MS

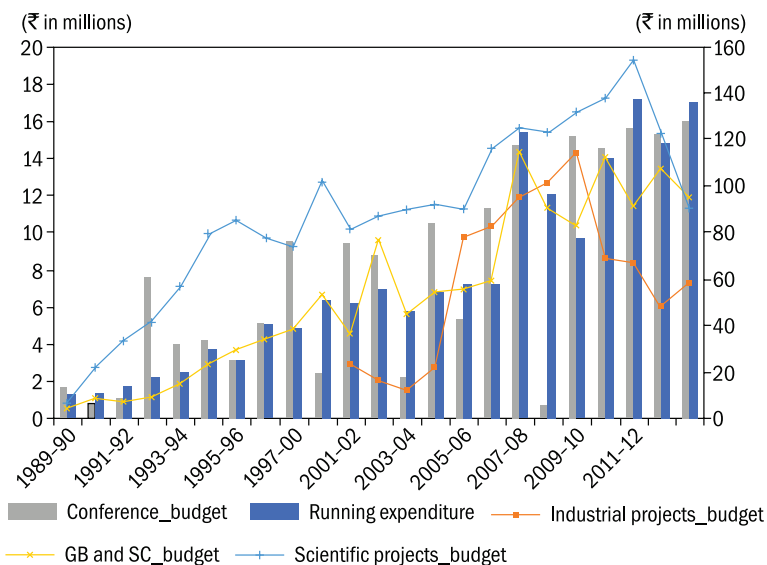


Figure 2.10: Expenditure under Different Activities

Note: Right Axis: Scientific project budget; Left Axis: Conference budget, Running expenditure, Industrial project budget, GB & SC: Governing Body and Scientific Council Budget.

Source: Constructed from CEFIPRA Annual Report

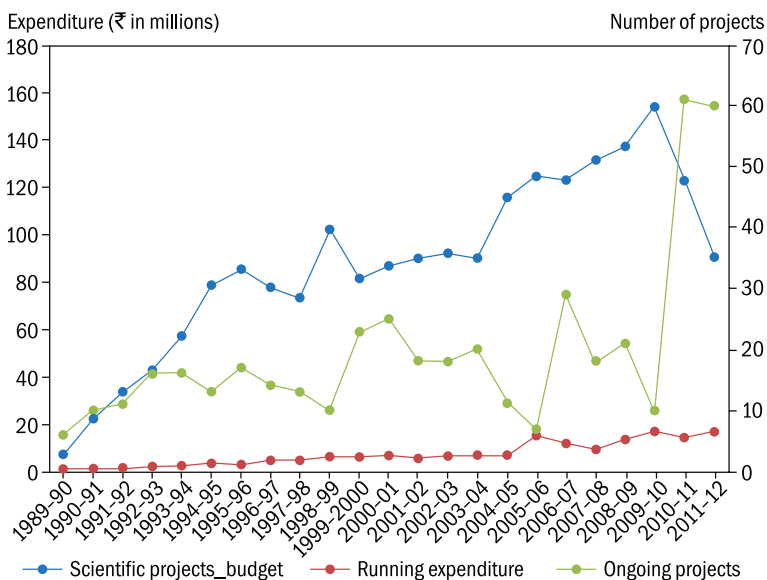


Figure 2.11: Ongoing Scientific Projects and Expenditure

the number of projects in that area. Differences do exist between different quartiles but is not significant. The

range of budget allocation project wise is 3.8 to 6.5; mean value in high quartile areas is 5.25, medium quartile 4.64, and

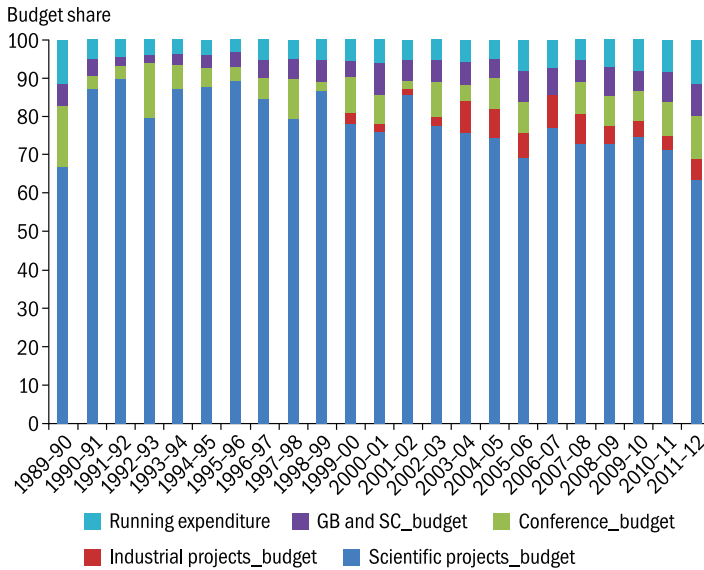


Figure 2.12: Share of Expenditure under Different Activities
 Source: Constructed from CEFIPRA Annual Report

low quartile 5.15. Thus CEFIPRA funding processes do not essentially distinguish between different thrust areas. However, depending on the nature of project there can be wide variations in funding between projects irrespective of the thrust area concerned.

Key Findings

- France undertook various policy initiatives for the promotion of innovation. GERD has increased substantially over the years and has given increased autonomy to universities. India started by putting innovation in the national agenda by declaring 2011–20 as the ‘Decade of Innovation’, creation of National Innovation Council and articulation of 2013 Science Technology Innovation Policy. Various initiatives by the Indian government have been observed to develop an innovation ecosystem with strong focus on inclusive innovation.
- India and France have identified common scientific areas of cooperation. The identified areas are contemporary areas of high scientific relevance or areas that address pressing global challenges. The primary objective is to strengthen the research and technological competency of both the countries. Efforts towards exploitation of the knowledge for social and/or economic outcomes are emerging as a new thrust area of cooperation.
- IFCPAR/CEFIPRA is an important outcome of the Indo–French bilateral partnership. The primary objective of CEFIPRA is to support collaborative research projects between Indian and French scientists; complement the expertise and strength of

high quality research groups in advanced areas of science and technology and promote excellence in science. Mainstay in the initial years of CEFIPRA was to provide an interface mechanism between Indian and French researchers/research groups through projects, seminars, exchange visits among others. This attribute remains as the major characteristic of CEFIPRA, i.e., to enable interactions between the active groups of the two countries. CEFIPRA is now involved in the whole knowledge value chain and supporting industrial research projects.

- CEFIPRA has evolved over the years; expanding its role to provide various types of interface mechanism to support Science, Technology and Innovation (STI) between the two countries. Among the key characteristics of its support are: promoting scientific research that has high merit and strong

support for developing research competency of young scholars. For example, one major checklist for project approval is to gauge the extent the young scholars are involved in the project.

- Many projects emerging from CEFIPRA exhibit significant scientific and technological outputs. These outputs are of high significance considering their social, technical, and industrial relevance. The maximum number of projects are funded in 'Life and Health Sciences' followed by 'Material Sciences'. Molecular Biology is also an important area of project funding. Projects have been funded in niche areas in the context of the year/period when they were supported. The Project in areas such as genetic engineering, membrane biology, protein interactions, and nanotechnology were supported when there were very few research centres working on these areas globally.



CEFIPRA: Human Resource and Capacity Development

Introduction

The key industries in the late twentieth century (such as microelectronics and telecommunications) as well as those of the twenty-first century (such as biotechnology and nanotechnology) are driven by science-based innovation. Scientific and technological competency and the ability to translate laboratory research to innovation and commercialization depends on other factors such as highly skilled manpower and strong academia-industry linkage. Thus, within an increasingly knowledge-based global environment; the ability to compete on skills and talent forms the frontline for winning the race for productivity and profit. Hence, it becomes imperative for countries to develop skilled workforce that can compete in the new environment.

Among various policy initiatives, various countries are undertaking the development of highly skilled manpower through international collaboration. This is taking place to deal with the global challenges such as climate change and various health issues which are enormous and may not be country-specific and require innovative solutions and complementary strengths of different countries to address them. Scientific and technological uncertainty of the promising new technologies also

requires inter-country collaboration. This has led to bilateral agreements among countries which are increasingly focusing on skill development and attempting to address skill gaps through mutual learning. Keeping this in perspective, an investigation has been done to see to what extent CEFIPRA funding is contributing in this direction that is helping in developing human resource and preparing the young researchers of both the countries to play a more effective role in knowledge-based industries.

CEFIPRA – Contribution to Human Resource Development

CEFIPRA works under the mandate of promoting advanced areas of fundamental and applied scientific research, and at the same time developing human resource and building scientific capacities. The capacity strengthening function of CEFIPRA contributes to many global knowledge systems by training scientists and supporting institutional development. These activities not only enhance synergies with many national and international scientific research systems but also help the scientists to solve problems of global concern. The institutional networks created with the support of CEFIPRA plays an important role in accommodating different views

among the collaborating partners to enhance STI capacities and ensure that the capabilities are linked to the societal needs as well. The scientific council of CEFIPRA has played an important role in this context. Among the important guidelines formulated in this regard, is the desirable requirement that each project supported through its funds provides doctoral and postdoctoral positions in the relevant fields. CEFIPRA provides an institutional platform for interaction of young researchers from both the countries

via workshops as well as encourage exchange of students.¹

Projects funded through CEFIPRA a substantial number of PhDs have been generated. For having a more informed view, thrust areas have been discerned in three quartiles which are further categorized as high, medium, and low based on the number of projects completed in each of them (Table 3.1). High quartile implies that the number of projects completed fall in the range 50 and above, medium quartile fall within 5 and 25, and low quartile below 5.

Table 3.1: Project Distribution in Different Thrust Areas

High Quartile	
Subject area	Projects
Life and Health Sciences	75
Pure and Applied Chemistry	52
Pure and Applied Physics	51
Material Sciences	69
Medium Quartile	
Subject area	Projects
Biotechnology	8
Water	8
Environmental Sciences	12
Earth and Planetary Sciences	15
Pure and Applied Mathematics	22
Computers and Information Science	14
Low Quartile	
Subject area	Projects
Technology for Information and Communication	4
Instrumentation	3

Source: Database constructed under this project

¹ *Ensemble*: Vol. 1 (1). January, 2013

It is estimated from the study that the total human resource involved in CEFIPRA projects until 2012 was around 2,590. This included principal collaborators, doctoral and Postdoctoral fellows. Among these, 53% of total human resource involved was from India while 47% was from France.

The section also depicts the institutes from both the countries that have actively participated through CEFIPRA funded projects. Discussion and feedback from Principal Investigators (PIs) of the funded projects was also undertaken by CEFIPRA to understand how they value the role played by this organization in enhancing their research competence, developing linkages, and

exploring new areas of research. The aspects felt by PIs are key attributes of this organization and areas that require attention have been highlighted. The response received from 160 PIs has been analysed to have a more informed view of how the research community of both the countries view this organization.

Strengthening Human Resource

The involvement of human resource in the different quartiles has been given in Figure 3.1. It can be observed that total human resource that is the number of research personnel involved in the projects has been roughly similar across

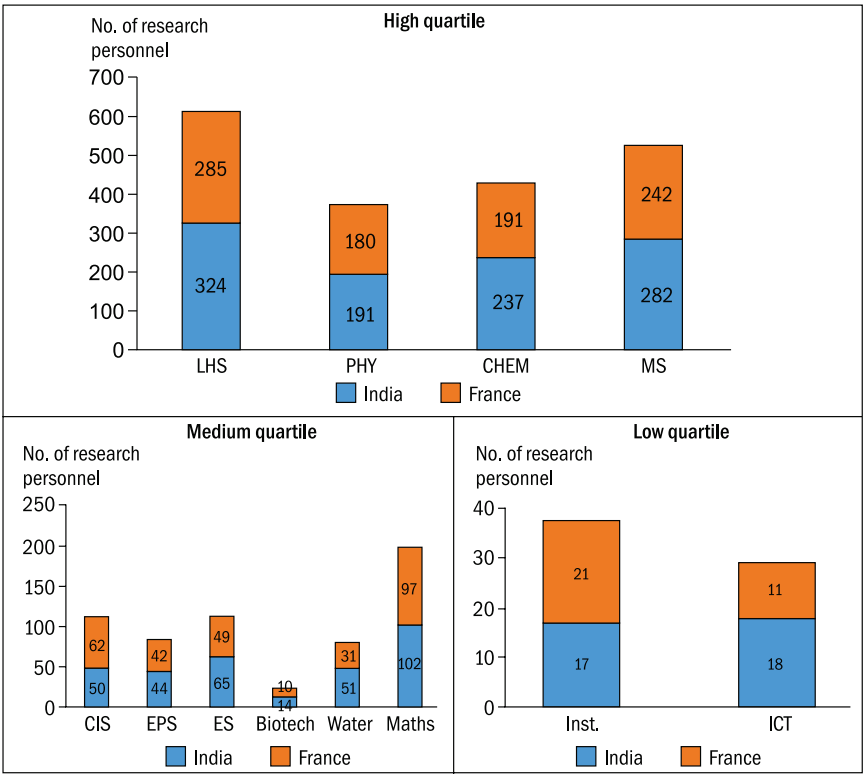


Figure 3.1: Human Resource in Different Thrust Areas
Source: Database constructed under this project

both the countries for different research disciplines. The manpower involved shows a correlation with size (defined in terms of the number of projects).

Exchange Visits

The past few years have seen a substantial growth in international cooperation globally. Increased investments in international facilities, joint programmes, and greater support for travelling abroad have provided opportunities for the scholars and research managers to join these international programmes for various benefits. CEFIPRA has helped many scientists across India and France to access the international scientific facilities and interact with peers through exchange visits. Through these

exchange visits CEFIPRA has helped provide students and institutions with opportunities to conduct international research, create local jobs, reduce the costs of research for involved parties, and minimize duplications of research efforts. The centre continues its role in enabling interactions between scientists of both the countries; an indication of this can be seen from 1,792 exchange visits till 2012 facilitated by CEFIPRA; of which 56% comprises Indian scholars visiting France and 44% French scholars visiting India.

It is important to state that there has been a complementary approach of knowledge sharing between the researchers of both the countries; as the number of exchange visits, have been roughly the same across the thrust areas as can be observed in Figure 3.2.

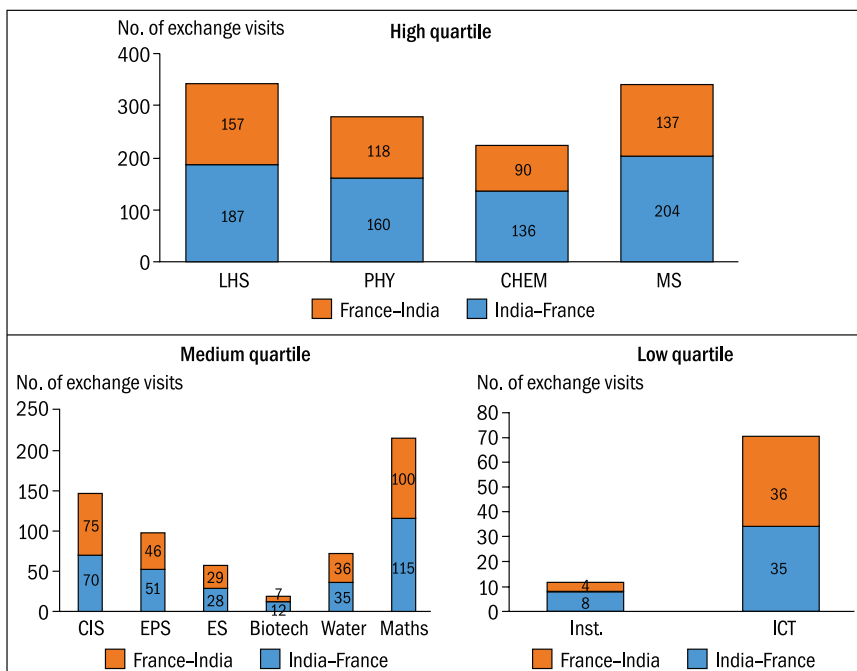


Figure 3.2: Exchange Visits in Different Thrust Areas

Source: Database constructed under this project

Seminars and Workshops

Over the past few years, numerous workshops and seminars have been held with the support of CEFIPRA. The seminars and workshops held are in areas of high priority and of mutual interest to both the countries with a mandate of exchanging information, knowledge, and expertise in the area and identification of areas for collaboration, institutions which can collaborate, and experts who can submit joint proposals. Proposals for organization of workshops and seminars are jointly submitted by the French and Indian scientists. They may be held in either of the countries. The seminars and workshops have been a forum for knowledge sharing between the scientists and technologists from the two countries. These seminars have

acted as catalysts in developing future joint collaborations between scholars of India and France.

The seminar themes cover a range of research topics and areas such as “trends in cancer research”, “instabilities and patterning in materials science”, “Indian monsoon modelling”, “dynamics Indo–French water week”, and “nutrition, inflammation and diabetes”. CEFIPRA has also organized seminars bringing in other stakeholders. For example seminar on Small and Medium Enterprise (SME) titled “Opportunities for Improving Competitiveness through Collaboration with French Partner” which was jointly organized with Visvesvaraya Industrial Trade Centre, Bangalore and Karnataka State Council for Science and Technology.

Figure 3.3 represents the year-wise trend of the seminars organized by

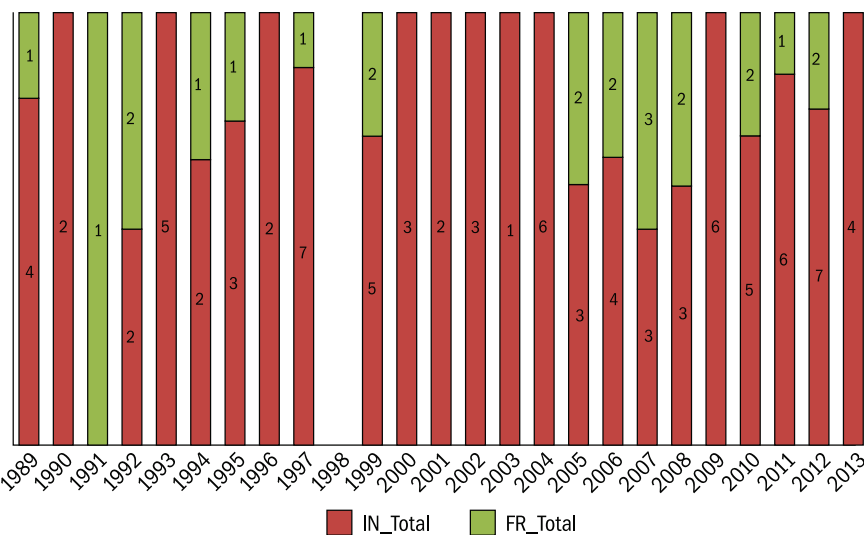


Figure 3.3: Longitudinal Trend of Seminars and Workshops Organized by CEFIPRA

Note: IN_Total indicates seminars/workshops held in India; FR_Total indicates seminars/workshops held in France

Source: Database constructed under this project

"I really enjoyed working in the IFCPAR sponsored project in collaboration with Prof. J M Guenet, Institut Charles Sadron, Strasburg, France (2003–05). I became enriched in different experimental techniques and learnt about the phase diagrams, and polymer solvent complexation in detail. The visit to different institutes of France also enriched my knowledge which has helped greatly in my research."

Arun K Nandi,
Sr Professor, Polymer Science Unit,
Indian Association for the Cultivation of Science, Kolkata

CEFIPRA in India and France. It can be noted that CEFIPRA has organized the maximum number of seminars and workshops in India as compared to France.

In the later years it can be observed that the seminars have been held predominantly in India. This may have adverse implications for getting access to potential, promising researchers in France.

Figure 3.4 shows seminars that were organized in different thrust areas. Seminars form an important forum for scouting of research projects. It can be seen that a majority of seminars were held in areas within physics, life and health sciences, and chemistry. One can observe seminars mainly happening in cutting-edge scientific research topics such as polymers science and engineering, cancer research, molecular

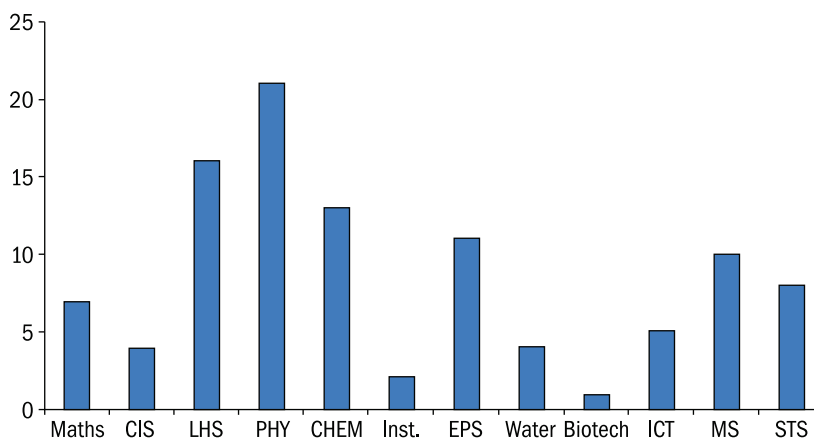


Figure 3.4: Seminars and Workshops in Different Areas (1987–2013)

Note: STS => Science Technology and Society

Source: Database constructed under this project

technologies, telecommunications, and nanotechnology.

**Institutional Linkages
Developed through CEFIPRA**

CEFIPRA through its support to collaborative projects has helped establish research linkages between the academic institutions of India and France. In India, top performing institutes in terms of the number of projects completed/ongoing funded by CEFIPRA have been Indian Institute of Technology (IIT) and Indian Institute of Science (IISc) whereas in France most of the projects have been funded to CNRS associated laboratories, CNRS laboratories, and universities. There have been a number of linkages in various fields including those of global concerns such as water, cancer, and environmental sciences. Institutes such as the Council of Scientific and Industrial Research–National Geophysical Research Institute (CSIR–NGRI) for research activity in water, Industrial Toxicology Research Centre (ITRC) for pharmaceutical research,

Council of Scientific and Industrial Research–Centre for Cellular and Molecular Biology (CSIR–CCMB) for cancer research, and King George’s Medical College (infectious diseases) have developed linkages with many institutes of France such as the CNRS laboratories and many other prolific institutes in France.

Figures 3.5 and 3.6 give the year-wise distribution of the collaborating institutes of India and France, respectively.

Number of Research Institutions or Universities and other Organizations in Collaboration with CEFIPRA till 2012

India-140 (counting CSIR, IISc, and DBT laboratories as single institutions)

France-61 (counting CNRS, INRRIA, and IRD laboratories as single institutions)

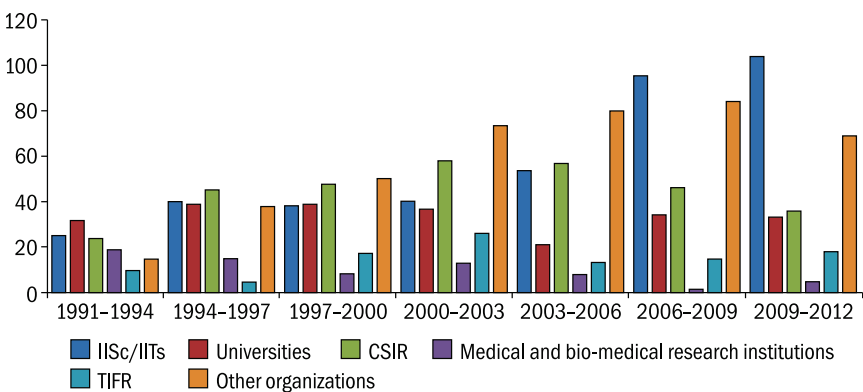


Figure 3.5: Major Institutions from India Involved in CEFIPRA Funded Projects
Source: Constructed from CEFIPRA Annual Reports

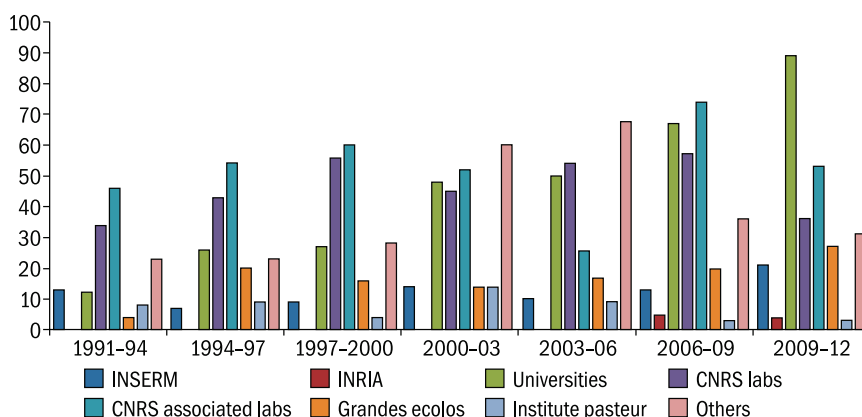


Figure 3.6: Major Institutions from France Involved in CEFIPRA Funded Projects

Source: Constructed from CEFIPRA Annual Reports

Table 3.2 highlights the institutions' linkages between both the countries that have developed through CEFIPRA funding.

Highly reputed institutes (universities or research organizations) in both the countries are primarily involved in joint research projects funded by CEFIPRA. However, in later years one observes the participation

of larger number of institutes in the CEFIPRA funded projects. This is one area where CEFIPRA needs to direct more attention.

Figure 3.7 shows the number of projects in different Indian institutions across the thrust areas.

From Figure 3.7 it can be seen that IISc has the maximum number of collaborative projects, 48, with 13 in life

Table 3.2: Linkages among Prolific Institutions from India (1987–2012)

	CNRS	CEA	University	INSERM	IRD	INRIA	Others	Total
IISc	19	2	11	2	2	1	10	47
TIFR	7	2	6	1	0	0	8	24
CSIR	35	0	12	1	0	0	21	69
IIT-Delhi	1	0	4	0	0	0	6	11
IIT-Bombay	6	0	0	0	0	0	5	11
IIT-Kharagpur	2	0	0	0	0	0	0	2
IIT-Kanpur	8	0	2	0	0	0	5	15
IIT-Madras	2	0	0	0	0	0	2	4

Source: Database constructed under this project

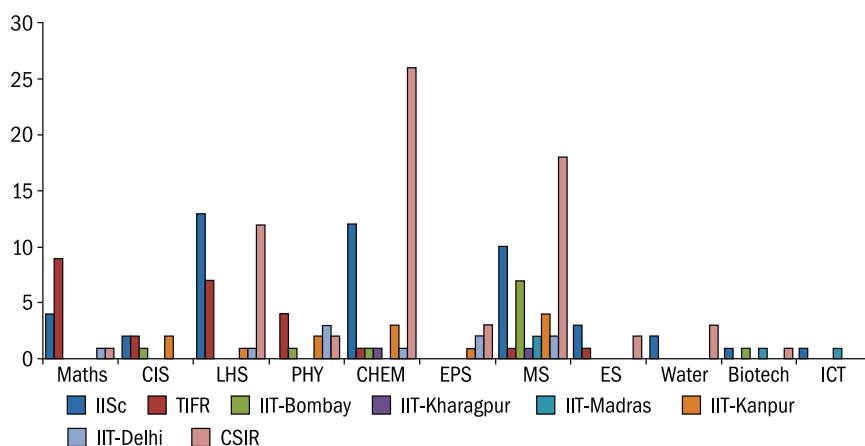


Figure3.7: Activity of Prolific Institutions in India from Different Thrust Areas (1987–2012)

Source: Database constructed under this project

and health sciences, 12 in chemistry, and 10 projects in material sciences. CSIR laboratories have mostly taken up projects in the area of pure and applied chemistry with 26 projects, followed by material sciences with 18 projects. TIFR has nine projects in mathematics and seven in life and health sciences.

Linkage Analysis in Prominent Sub-Areas

Bilateral collaboration in key disciplinary areas promotes understanding of complex problems and global challenges. CEFIPRA identifies promising areas where India and France can add value through collaborative linkages. Seminars and workshops are organized in the identified areas and call for proposals are given in them periodically. This proactive action has helped to develop research linkages in water, nanotechnology, cancer research, infectious diseases, and earth and planetary sciences.

An important outcome of the Indo–French Science and Technology Agreement was the establishment of the Indo–French Cell for Water Science (IFCWS) at the IISc. The cooperation agreement between ‘Institut de Recherchepur le Developpement’ (IRD) and IISc, Bangalore based on the MoU signed in 1999 helped in establishing this centre. CEFIPRA strengthened this laboratory by supporting projects. Another laboratory with similar efforts has been established in cooperation between the NGRI Hyderabad and BRGM in ground water research. Table 3.3 shows the linkages in water which have been established through CEFIPRA supported projects.

Through CEFIPRA, institutes in India which emphasize on cancer research have developed linkages with institutes working on the same areas in France. The collaboration between Department of Haematology, Christian Medical College, Vellore and Hospital Saint Louis Instituté of Universitaire Hématologie Paris which worked on

Table 3.3: Institutional Linkages in CEFIPRA Supported Projects in Water

Indian Institute		French Institute
University of Kalyani	<->	Lab De GeographiqueInternetTechnophysique Univ. De Grenoble
CSIR-National Geophysical Research Institute, Hyderabad	<->	Centre D'InformatiqueGeologiqueEcole Des Mines De Paris URA CNRS 1367, Fontainebleau. Institute, National
Industrial Toxicology Research Centre, Lucknow	<->	Lab Environment Et MineralurgiePolytechnique De Lorraine Vandoeuvre.
CSIR-National Geophysical Research Institute, Hyderabad	<->	Centre Scientifique Et Technique Burea De RechercheGeologique Et Miniere Orleans.
Indian Institute of Science , Bangalore	<->	Laboratoire Des Mechanisms Des Transferts En Geologie, Toulouse
CSIR-Central Electrochemical Research Institute, Karaikudi.	<->	Lab. De Atalysis En ChimieOrganiqueUMR 6503 CNRS Univ. De Poitiers.
Jawaharlal Nehru University, Delhi	<->	Lab De Glaciologie of Geophysique De 1'Environment Ird-Ur 032, Great Ice St. Martin D'Herès

Source: Database constructed under this project

Table 3.4: Institutional Linkages in CEFIPRA Supported Projects in Cancer

Indian Institute		French Institute
CSIR-Centre for Cellular and Molecular Biology, Hyderabad	<->	Inst. De Researches 'Signalisation, Biologie Da Developement Et Cancer' Centre De Biochimie CNRS – INSERM Univ. Nice, Sophia - Antipolic, Nic
Cancer Institute ,Chennai	<->	Section Medicale Inst. Currie, Paris
Institute of Pathology, New Delhi	<->	Univ. Elade Bernard Lyon 1, Lyon
North-Eastern Hill University, Shillong	<->	Lab. De Chemic Therapeutique UMR CNRS 1310 Univ. Rene Deseartes, Paris
Breach Candy Medical Research Centre, Bombay	<->	Lab D' OncologieMoleculaire Univ. Paris Vii, Paris
University of Hyderabad	<->	Lab Am3 Faculte Des Sciences Et St. Jerome Techniques Univ. D' Aix-Marseille Iii, Marseille
CSIR-Indian Institute of Chemical Technology, Hyderabad	<->	Inst. De Chemic Des Substances Naturaltes CNRS Gif Sur Yvette
CSIR-Regional Research Laboratory, Thiruvananthapuram (Currently – CSIR- National Institute of Interdisciplinary Science and Technology)	<->	Lab Raymond-Latarjet UMR 176 CNRS Inst. Curie, Orsay
Indian Institute of Science ,Bangalore	<->	Deptt. De ChimieEcoleNormaleSuperieure, Paris
University of Pune	<->	Lab. De ChimieEfBiologie Des Metouxlrtsv/LCBM, DRDC

Source: Database constructed under this project

the overall goal to study the effects of novel agents used in the treatment of acute promyelocytic leukaemia on the immune response through preclinical studies in mice models and ongoing clinical trials in patients, have been examples of such successful institutional linkages. The productive association with CEFIPRA has helped in establishing a world class cancer research centre in India. Table 3.4 shows the linkages in cancer which have been established through CEFIPRA supported projects.

The project between the microbiology division of Central Drug Research Institute (CDRI), Lucknow and Institut Pasteur de Lille, Lille,

which was set to identify the genes of *Mycobacterium tuberculosis* in pathogenesis of tuberculosis and survival of tubercle bacilli was not only successful in their objective but also it allowed the team members to access delicate steps in genetic engineering. Table 3.5 shows the linkages in infectious diseases which have been established through CEFIPRA supported projects.

The collaboration of IIT-Delhi with Laboratoire de Meteorologie Dynamique led to the formation of an active research group in meteorology in the mathematics department of IIT-Delhi in 1975. The activities of this group led to the formation of an

Table 3.5: Institutional Linkages in CEFIPRA Supported Projects in Infectious Diseases

Indian Institute		French Institute
University of Delhi, New Delhi	<->	MorphogenseVegetale Et Experimentale Univ. De Paris-Sud, Orsay.
King George's Medical Coll. Lucknow	<->	INSERM Unite 271 Lyon
National Centre For Cell Sciences, Pune	<->	Unite D'ImmunoChimieAnalytique CNRS URA 1961 Inst. Pusteur, Paris
Department of Biological Sciences TIFR Mumbai	<->	ParasitologieBiomedicalesInstt. Pasteur, Paris
Indian Institute of Science, Bangalore	<->	Unit De Biologie Des Interactions Hole-Parasite Inst. Pasteur, Paris
Jawaharlal Nehru University, Delhi	<->	Lab De GenomiqueUmr 8541, CNRS- Ens, EcoleNormale, Superieure, Paris
National Centre For Cell Sciences, Pune	<->	Inst. Pasteur Paris
Tata Institute of Fundamental Research, Mumbai	<->	Centre For ImmunologieEf De BiologieParasitaire Inst. Posture De Lille, Inserm U547, Lille.

Table 3.5: Institutional Linkages in CEFIPRA Supported Projects in Infectious Diseases

National Institute of Virology, Pune	<->	Dept. of Virology Inst. De Pasteur, Paris
National Institute of Immunology , New Delhi	<->	INSERM Csf 92 09 Hopital Antoine Beclere Clamart
Malaria Research Centre, Delhi	<->	INSERM U 313 EnuPitie Salpetrieve, Paris

Source: Database constructed under this project

Table 3.6: Institutional Linkages in CEFIPRA Supported Projects in Environmental Sciences

Indian Institute		French Institute
TERI New Delhi	<->	Centre De Researches De Nancy INRA Unite Ecosystems Forestieres Champenoux
Indian Institute of Science, Bangalore	<->	Lab D' Ecologic Experimentable Et Comparee CNRS URA 258 Univ. Pierre Et Maire Curie, Paris
NIO, Goa.	<->	Lab De Geologie Et Environnement CNRS UMR 6536 Univ. D' A'k Marseille Aix-En-Provence.
University of Mumbai	<->	Ecole National Superieure De Ingenieurs, Arts, Et Genie Chimie Toulouse
CSIR-Centre of Cellular and Molecular Biology, Hyderabad	<->	Lab Agago Univ. Paris Vi, UMR CNRS Banyals-Sur-Mer
Centre For Ecological Sciences, Indian Institute of Science , Bangalore	<->	Centre D' Ecologie Fonctionnelle Et Evolutive, Du CNRS Montpellier
Indian Institute of Astrophysics, Bangalore	<->	Lab Des Sciences Du Climat Et De L' Environnement UMR, Cea-Cnrs Gif-Sur-Yvette.
National Bureau of Soil Survey & Land Use Planning, Bangalore	<->	Cirad Montpellier
Indian Institute of Science, Bangalore	<->	Museum National D' Histoire Naturelle, Paris
Osmania University. Hyderabad	<->	Microbiologie Adaptation Et Pathogenie UMR 5240, CNRS - INSA - Ucb Villeurbanne

Source: Database constructed under this project

independent “Centre for Atmospheric Sciences (CAS)” in 1981. The Indo–French collaboration between IIT–Delhi and LMD is now progressing under the IFCPAR/CEFIPRA project; the climate change model developed under IFCPAR/CEFIPRA project was used to investigate the connection between clouds and the cosmic rays.

L’Institut de Recherche pour le Développement (IRD), France and the School of Environmental Sciences, Jawaharlal Nehru University (JNU), India collaborated to monitor a glacier over a long term, in Himachal Pradesh (Chhota Shigri Glacier). After five years of light monitoring (annual mass balance measurements), in attaining the standards of GLACIOCLIM (the Glaciers, an Observatory of the Climate that is mass balance, energy balance, and hydrological balance monitoring, it is now recognized as the most important benchmark Himalayan glacier by the international

scientific community and the WGMS (World Glacier Monitoring Service). This glacier is now a part of the worldwide GLACIOCLIM observatory, which provides the financial support requested to ensure the monitoring network over the long-term (several decades). On this project, CEFIPRA has not only helped to strengthen the collaboration between IRD and JNU, but has also developed a monitoring network to reach international standards.

The research project titled “Risk of cracking of clay liners for landfill capping and environmental hazard” was undertaken between IIT–Bombay, India and LTHE, University of Joseph Fourier 1, Grenoble, France. This project has played an influential role in addressing the problem of environmental hazards. Table 3.6 shows the linkages in environmental sciences which have been established through CEFIPRA supported projects. Table 3.7

Table 3.7: Institutional Linkages in CEFIPRA Supported Projects in Nanotechnology		
Indian Institute		French Institute
CSIR- National Chemical Laboratory, Pune	<->	Laboratoire De Physique Des Solides Univ. Paris-SudOrsay
IIT Mumbai	<->	Service De ChimieMoleculaireCea- Saclay Gif-Sur-Yvette
Lucknow University	<->	Lad De SpectrochimieInfrarouge Et Raman UMR 8516, CNRS/Ustc Lille
EC University. of Technology, Chandigarh	<->	Univ. De Rennes 1, UmrCnrs 6510, Rennes
Indian Institute of Science, Bangalore	<->	SntheseEfelectrosyntheseOrganiquesCnrs, Umr 6510, Univ. De Rennes 1, Insttt. De Chimie, Rennes

Table 3.7: Institutional Linkages in CEFIPRA Supported Projects in Nanotechnology

Indian Institute		French Institute
Indian Institute of Science, Bangalore	<->	Instt. Des Sciences, Moleculaires, CnrsUmr 5255, Univ. Bordeaux 1, Talence
CSIR- Indian Institute of Chemical Technology, Hyderabad	<->	UMR 6226, CNRS Univ. De Rennes I, Rennes
IIT, New Delhi	<->	Lab De Physique De La MatiereCondensee CNRS UMR 6622 Univ. De Nice Sophia Antipolis Nice
S. N. Bose National Centre For Basic Sciences, Kolkata	<->	Lab. Des Physique Des Solides, Orsay
University of Pune	<->	Deptt. De RechercheFondamentale Sur La MatiereCondensee, Cea, Grenoble
Indian Institute of Science , Bangalore	<->	Lab De Chimie Des MateriauxInorganiquesUra CNRS 1311 Univ. Paul Sabatier Toulouse.
CSIR- Centre For Excellence In Chemistry, Indian Institute of Science, Bangalore	<->	Lab De ChimieMateriauxInorganiquesUra CNRS 1311 Univ. Paul Sabatier Toulouse.
Indian Association For The Cultivation Of Science, Kolkata	<->	Instt. De Charles SadronCrm-Eahp CNRS Upr 22, Strasbourg
University of Pune	<->	Lab Femto-St, Deptt. Lpmo, Besancon
International Advance & Research Centre For Power Metallurgy & New Materials, Hyderabad.	<->	Lab Simap-Gpm2, INGP CNRS Damaine Univ. St. Martin De Heres
Jawaharlal Nehru Centre For Advanced Scientific Research, Bangalore	<->	Lab. MateriauxEffPhenomenesQuantiques, CNRS UMR, 7162, Univ. Paris, Diderot Paris.

Source: Database constructed under this project

shows the linkages in nanotechnology which have been established through CEFIPRA supported projects.

Apart from the above research domains, there are several other

projects supported by CEFIPRA which have led to successful outcomes and contributed towards developing strong linkages (Annexure III).

Capacity Creation

One of the objectives of CEFIPRA is to strengthen the research capacity of both the countries. This section discusses the capacity creation as an outcome of CEFIPRA funded projects. This section has been divided into three sub-sections: (a) geographical distribution of projects, (b) views from principal investigators of CEFIPRA funded projects, and (c) industry-academia linkages developed through CEFIPRA industrial projects.

Geographical Distribution of Projects

Figures 3.8 and 3.9 shows the cities that attracted maximum number of CEFIPRA funded projects in India and France. In India, it can be observed that Bangalore has the highest gamut of projects, however in the initial years (from 1991–2000) Delhi had the maximum number of projects as compared to the rest of the cities. Quite unlike India, in France; right from the formative years Paris had the highest concentration of projects as compared to rest of the cities.

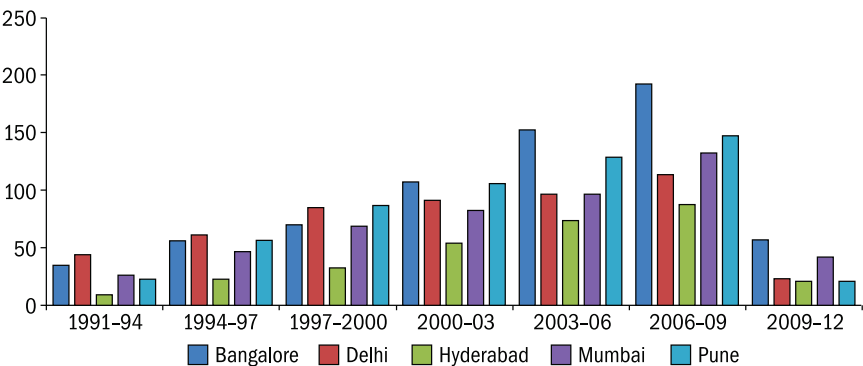


Figure 3.8: Year-Wise Distribution of Projects in Cities of India
Source: Constructed from CEFIPRA Annual Reports

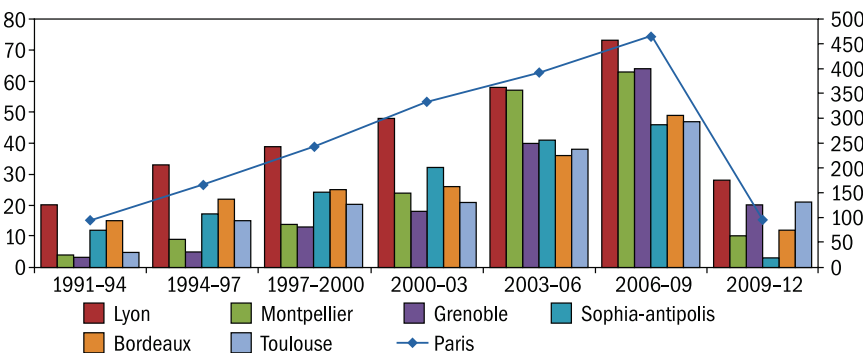


Figure 3.9: Year-Wise Distribution of Projects in Cities of France
Source: Constructed from CEFIPRA Annual Reports

Views from the Principal Investigators (PIs) of CEFIPRA Funded Projects

Detailed analysis done on CEFIPRA, through various available resources, show that there has been capacity-building along with other aspects of knowledge sharing through CEFIPRA funding. In addition, the pertinent information has been provided by the PIs of the funded projects. CEFIPRA requested the PIs to send their feedback on completion of 25 years. A sample of 160 PIs responded to CEFIPRA's request out of the total number of PIs for feedback.

Table 3.8 provides an insight into the motivation of international collaboration. It also highlights the driving factors for the scholars from emerging economies and advanced countries to collaborate. However, the readers need to be cautious not to generalize this, as they are in

the context of responses observed from projects funded by a bilateral institution. In spite of this limitation, the responses point out to some important aspects. Access to new knowledge or data sources stands as the most important driving force for joint collaboration. It shows that growing complementary knowledge strength is what most researchers look for. Thus the intervention mechanism should be in this direction to bring together researchers who are working on similar problem areas.

The flexibility mentioned in the table is not in terms of academic dilution but operational flexibility. Possibly this flexibility is missing in funding obtained from other sources.² One understanding is that CEFIPRA should not change this characteristic. Through the project there were formal and informal collaborations not only between principal investigators but there was also strengthening

Table 3.8: Feedback Analysis

Attribute	Principal investigators (%)	
	India	France
Access to new equipment	39	15
Access to new knowledge/ Data sources	76	70
Access to new laboratories	43	28
Sharing of research data	50	51
Solving global research problem	20	22
CEFIPRA flexible in terms of its objectives	86	83
Continuation of research collaboration	37	29

Source: Based on Feedback of Principal Investigators of projects funded by CEFIPRA Total sample: 160 responses

² Based on CEFIPRA 'Brainstorming' workshop held on August 21, 2013.

of relationships between institutes which led to further collaborations and widening of arenas resulting in creation of more research opportunities.

Notable Achievements of CEFIPRA Research Projects

CEFIPRA, ever since its inception in 1987, has strongly encouraged fundamental research. Further, it expanded its scope to accommodate industrial research and applied research. The affirmed model is that of a bilateral science and technology cooperation which could lead to a strategic partnership between India and France. The whole dynamism of strengthening scientific research programme covers large number of different facets of cooperation such as (a) advancing knowledge (fundamental science), cross fertilization, solution science, (b) catalysing multi-disciplinarity/interdisciplinarity in areas of research, and (c) supporting research that can address societal and/or market needs such as in energy, health, climate change mitigation, and green technology. The suggested action/mechanisms of knowledge forward chaining, alignment with national research capacity-building needs, virtual knowledge network centres, flagship programmes, encouraging exchange visits, and development of new programmes with industrial partners.

CEFIPRA's intervention has been primarily in three areas one is the value of the knowledge generated by projects supported by CEFIPRA, other is how CEFIPRA can improve its intervention mechanism of knowledge generation and lastly how linkages

may help in forwarding knowledge generation through Indo–French science and technology cooperation. The priority is vested on supporting cutting-edge scientific research, new promising areas, and areas of global challenge. Nurturing areas or ideas when they were beginning to evolve, stem cell research, nanotechnology research, funding new multidisciplinary areas in STEM (Science, Technology, Engineering, and Mathematics), and an inclusive approach.

Involving young researchers and providing them opportunities to develop research competency is

“My association with IFCPAR started way back in 1997, when a project proposal was submitted jointly by me and Dr Jerome Dymont, who at that time was affiliated to CNRS. The project resulted in providing detail delineation of the paleo-propagators — the imprints of a unique tectonic phenomenon, which was active in this part of the Indian Ocean between 46 and 63 million years before present. I believe that the project surely would not have succeeded, in the way it did, if we had not received the excellent support from the IFCPAR during the entire tenure of the project.”

G C Bhattacharya,
Scientist, Geological
Oceanography Division
National Institute of
Oceanography, Goa

an integral component of CEFIPRA projects. CEFIPRA's funding support has led to some very long associations developing between individual researchers and institutes of both the countries. Many associations which developed earlier between India and France were strengthened through CEFIPRA's funding support. Some of the areas from CEFIPRA funded project have shown important results. The following projects are of such kind in major research domains.

Earth and Planetary Science:

"Aerosols and Indian Monsoons" (No. 1911-2). The climate-chemistry model developed under this project was used to investigate the connection between clouds and cosmic rays. An ion-induced nucleation parameterization was implemented in the model and it was found that the primary particles played an important role in the indirect radiative forcing. Two processes were developed to study the radiative impact of aerosol on weather and climate. Moreover, the original work of a PhD student on the development of a scheme to achieve almost diffusion-free transport on icosahedral-hexagonal grids in a global model was indeed inspired by a paper of Dr Frederic Hourdin of LMD, on transport. This work has now become the focus of cooperation between IIT-Delhi and LMD-Paris.

"Development of a non-hydrostatic finite volume icosahedral model for regional or global climate simulation and weather forecast" (4107-1) Through this project "monsoon general circulation model" was redesigned as LMDZ and made highly sophisticated for implementation on supercomputers at

LMD and it is one of a kind among the other global models with its capability to "zoom" over a region of interest.

Water: "Enhanced processes for the removal of nitrate from water" (3800-W1). The project achieved to reach the standards of GLACIOCLIM (the Glaciers, an observatory of the climate; that is mass balance, energy balance, and hydrological balance monitoring). Process found: Process found and developed Catalyst PdSn/Al₂O₃ & PdSn/TiO₂ and nano-electrocatalysts PdSn/Ti & PdAg/Ti and two routes the catalytic & electrocatalytic compared Developed a 25A (1.5L/hr) capacity electrochemical nitrate removal unit to treat maximum of 1,000ppm nitrate. Additionally, an electrocoagulation process (0.5L/hr) was developed for nitrate removal without intermediates. Furthermore, a joint patent was filed by India and PCT and a publication was released in two SCI journals with an impact factor of 5.556.

'Optimal Development and Management of Groundwater in Weathered-fractured aquifers.' (2013-1). There were two outcomes of this project; (a) Developed an appropriate model of the unsaturated/partially saturated zones in the weathered rock overlying the fractured zone, and (b) Derived calibration of the catchment model from the precipitation and piezometric data.

Life and Health Sciences: *'Prognostic Values of Cytokines in Cervical Cancer'* (2004-1). This project analysed polar and lipophilic adducts and found that the levels of adducts formed were independent of severity of disease status. The 8-oxodG could be used as a

marker to reflect patients' potential to fix the lesion and respond to radiation therapy.

'Evaluation of Cellular and Immune response in mice and patients with acute promyelocytic leukaemia treated with arsenic trioxide' (4503-2). Exploring the role of the innate and adaptive immune system and its role in maintaining durable remission in this clinical condition was the objective of this project.

'Analysis of protein flexibility in biological recognition' (4003-2). The outcomes from this were, the development of new insights into protein recognition in biology (through systematic studies of known protein-protein complexes), a field of great importance for understanding the normal function and pathologies in all organisms. Development of databases to analyse structural and dynamics' properties associated with protein-protein complex formation. The databases created and exploited hand-in-hand with the development of new software tools designed to enforce both the consistency of the data and facilitate their accessibility.

'Protein transport in Plasmodium falciparum infected erythrocytes' (2503-1). The study unfolded an essential role for parasite coded chaperone of heat shock protein 90 family. The chaperone was shown to play a pivotal role in orchestrating an essential developmental transition in the parasite. The study also resulted in the identification of parasite heat shock protein 90 as a novel drug target and benzoquinone ansamycin group of compounds as candidate drugs against malaria. Uncovering new facets of the role played by Clag

9 in the pathogenesis of malaria, this study is likely to have had an important impact on understanding the mechanisms and components involved in cytoadherence properties of the parasite and understanding the biology of chaperone proteins in the parasite.

Environmental Science: *'Study on factors prevailing for the selection of mycorrhizal strains in ash pond'* (2109-1): This project led to the development of understanding of ash ponds and factors that helped to develop fly ash reclamation technology later. Two MSc Dissertation, one PhD, one post-doc, and five publications resulted from this project. It also led to fly ash reclamation in Korba Super Thermal Power Station. This novel method had a promising potential for the treatment of industrial waste.

'Risk of cracking of clay liners for landfill capping and environment hazard' (3809-1). The study demonstrated the use of centrifuge model testing to understand the hydro-mechanical behaviour of landfill cover barriers at the onset of differential settlement. For the first time, unique large beam centrifuge facility available at IIT-Bombay, India was used. The study examined the gas permeability behaviour of moist-compacted soil beams with and without fibre reinforcement subjected to demonstration through custom designed and developed test setup.

Biotechnology: *'Role of Glutathione Transporters in Stress Tolerance'* (2700-B1). The proposal aimed at understanding the functioning of glutathione transporters from yeasts and plants and investigating their role in glutathione homeostasis and stress

tolerance. This project was successful in characterizing the glutathione homeostasis and stress tolerance from yeasts and plants.

'Synthesis and Structural Studies of N-Glycoprotein Analogs' (3200-B1). The side project on neutron crystallography of models of N-glycoprotein linkage resulted in the determination of the correct localization of hydrogen atoms, therefore, confirming the occurrence of trifurcated hydrogen bonds and establishing the role of hydrophobic contacts.

Pure and Applied Mathematics:

'Mathematical Topics in Hyperbolic Systems of Conservation Laws' (2601-2). The collaborators investigated the properties of weak (discontinuous) solutions of some non-linear partial differential equations of hyperbolic type, mainly systems of conservation laws arising in continuum physics, and brought about the derivation of new estimates on the non-linear interaction taking place in solutions of the augmented hyperbolic system, including wave interactions involving resonant waves.

'Theoretical Study of Electronic AND' (1901-1). This project carried out a calculation of the caloric curves and melting temperatures of selected sodium clusters, in excellent agreement with experiment. Calculations of the temperature-dependent polarizability of Na clusters, developed jointly in-house real-space codes for spin-density functional theory and configuration interaction, which were used to study quasi-2D quantum dots of various shapes and sizes.

'Chaos, Turbulence and Collective Relaxation in Non-Equilibrium Plasmas'

"I have been associated with IFCPAR for almost 20 years and its actions for bilateral collaboration in science and technology between India and France, since I first participated in an IFCPAR meeting in 1992. I was a member of the Scientific Council from 1993 to 1996. For me it was a fantastic experience to discover all fields of Indian research and to learn much about India, in a friendly context with distinguished Indian colleagues and IFCPAR administration and its director, Mr Mony. It was a great pleasure to work at promoting bilateral projects especially in astronomy, in the context of such a strong and unique collaboration framework."

Alain Omont

Research Director,
Institut d'Astrophysique de Paris,
CNRS

(1301-1). The study conducted through this project was beneficial for radiofrequency heating schemes of fusion plasmas and helped in understanding energization of particles in space plasmas. The development and commissioning of LVPD (Large Volume Plasma Device), besides its engineering and technological achievements, has established a major facility for carrying out a host of basic plasma studies.

Pure and Applied Chemistry:

'Catalysis of organic reactions using novel heterogeneous modified clay-

catalysis' (1106-2): Many solid acids have been discovered and applied in the context of refining, for instance zeolites, clays, mixed oxides or sulphates. This was done with regard to the substitution of liquid successful first principles acids and bases by solids as catalysts in organic reactions for a better preservation of environment.

Material Science: *'Research of new layered oxides for energy storage and conversion'* (4608-2). Generation of new electrode materials through soft chemistry reaction, a great potential for the discovery of new electrode materials in view of various applications mainly for Li ion batteries.

'Novel hydrophobically modified polymers: Synthesis, characterization and rheology' (2508-1). The Indian research team at CSIR-National Chemical Laboratory established strong research collaboration with the French team, which had done pioneering work in the area of associating and thermoassociating polymers. Due to this collaboration, the Indian research team got an opportunity to venture into this interesting and fascinating area of hydrophobically modified polymers. The newly designed HMPs based on PAA-g-3-PDCA showed enhanced rheological properties as compared to their unmodified precursors. This is one of the first examples of thermoassociating polymers where viscoelastic properties can be controlled from very low to high temperatures. A new hydrophobic compound namely 3, 4, 5-tris dodecyloxy benzoyl azide starting from gallic acid was successfully synthesized. It was subsequently utilized for synthesizing hydrophobically end-

capped PEGs. These polymers exhibited excellent rheological properties in the presence of surfactants.

Polymer Science: *'Investigation of Superconductivity of Superconductivity and Magnetism'* (1808-1).

This project led to the discovery of superconductivity at a fairly high critical temperature $T_c = 12\text{K} - 15\text{K}$, in the multiphase quaternary system Y-Ni-B-C which has resulted in a new family of quaternary intermetallic borocarbides, $\text{RENi}_2\text{B}_2\text{C}$ (RE = Y, rare earth).

'Polymer Materials with Multiscale Porosity' (2808-2). This project was intended to evaluate the feasibility of multi-porous materials with porosity extending from the mesoscopic level down to the nanoscopic range (typically $0.1\text{ }\mu\text{m}$ down to 0.5 nm). Through this project making of porous materials that have paved the way for applications as de-pollution filters was achieved.

Industrial Project Support Developed through CEFIPRA

The primary goal of CEFIPRA's industrial projects is to provide a platform for French and Indian industries to collaborate with research institutions. This section brings out policies and programmes adopted by CEFIPRA towards industrial involvement through linking companies, academia, and scientific institutions. A record of industrial projects completed so far is presented and the diverse outcomes have been listed. The policy of the Centre towards intellectual property and the process of getting industrial funds are briefly looked at.

CEFIPRA in the initial years had focused on supporting cutting-edge

areas of scientific research. In later years, one could observe its support to industrial-oriented projects. In 1993, the governing body of CEFIPRA decided to involve scientists from industries, and a sub-committee was set up to look after industrial projects, with the first project with industrial partners getting approval in September 1998. The Centre has been making efforts to sensitize the industrial sector of the two countries to the opportunities through its projects involving industry. Seminars, workshops, meetings, and symposia have been organized lately to strengthen the industry-institutions collaboration.

Industrial Research Committee of CEFIPRA in 2001 floated a programme of 'Bridge' projects to ascertain through validation/testing, the feasibility of research ideas at various levels of knowledge generation. In CEFIPRA's industrial research projects, there is direct participation from the industry from the proposal stage itself. This approach is expected to lead to better translation of R&D into processes/products for commercial purpose. Till 2012, a total 16 joint industrial projects were recommended for support and 10 have already been completed.³

Table 3.9 shows the areas under which industrial projects were undertaken. (Refer Annexure IV for details).

It is to be noted that for CEFIPRA's industrial research projects the proposal must be industry-centric, needed by industry and focus on industry priorities. An industry from France or India and a research institution from both the countries must be involved. Partnerships with more than one industry or one research institution are also possible. The proposal may address development of process, product or design; translate R&D lead into a commercializable product and joint R&D development for industrial application. Figure 3.10 shows the steps involved in the approval process of industrial projects followed by CEFIPRA. The projects are approved for funding only after a rigorous screening process. The research is done in areas of interest of both the countries.

Figure 3.11 highlights some achievements of CEFIPRA funded industrial projects. CEFIPRA helped in the development of the drug 'misoprostol' for commercial market. Misoprostol is an antiprogesterone drug that is given to the patient

Table 3.9: Industrial Projects Funded in Different Thrust Areas*

Subject category	Completed projects	Subject category	Completed projects	Subject category	Completed projects
CIS	1	MS	1	LHS	1
EPS	1	CHEM	1	Inst	1
ES	1	Maths	1	PHY	2

* Ongoing projects not included here.

Source: Captured from different CEFIPRA industrial project documents (completed till 2012)

³ Complete information about other industrial projects could not be gathered.

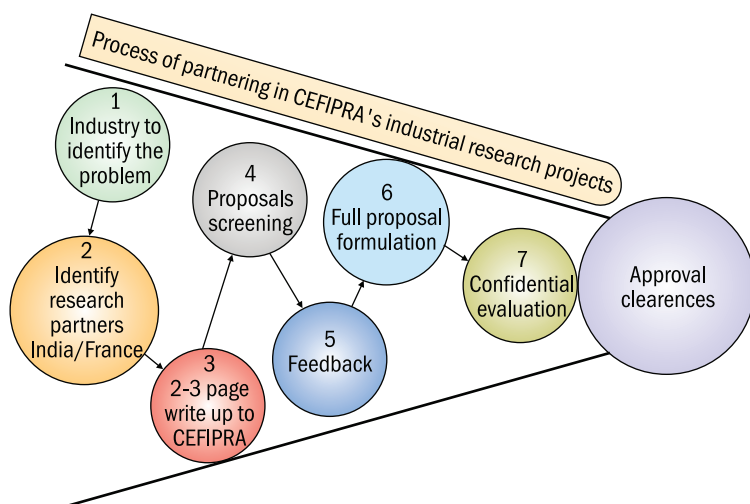


Figure 3.10: Approval Process of Industrial Projects followed by CEFIPRA

Source: Captured from different CEFIPRA documents

after 24 hours of giving the RU 486 (Mifepristone) drug to complete the process of abortion. Misoprostol is also used as a drug for ulcer and gastric cure. The collaboration between ZydusCadilla and AVRA helped to produce the RU 486 drug but Misoprostol was still required to be imported. CEFIPRA supported

the project undertaken jointly by the CSIR-Indian Institute of Chemical Technology (IICT), Hyderabad and the University of Rennes helped to develop Misoprostol for taking up production in a commercial scale.⁴ This drug has helped in controlling fertility in India as well as globally. Also from the industrial project, many new enzymes and other

IPR and CEFIPRA

The Centre has evolved guidelines for Intellectual Property Rights (IPR), on the basis of extensive discussions between the governments of both the countries. The partners of the industrial research projects are expected to enter into an IP Agreement before the project commences.

Also, all collaborators working on IFCPAR projects are encouraged to protect their findings and outcomes through patents and copyrights. It was also decided in the 1999 meeting that projects with industrial significance should be patented and there should be continuous support from the centre for the maintenance of intellectual rights in those projects. The projects funded by the centre till 2012 has resulted in 17 patents.

⁴ Ensemble: Vol. 1 (4). July, 2013.

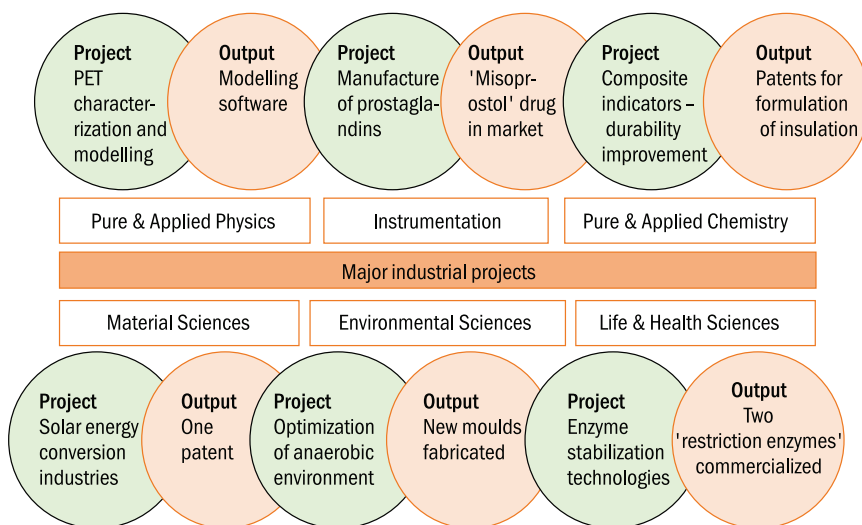


Figure 3.11: High Impact Industrial Projects

Source: Captured from different CEFIPRA documents

materials have been synthesized in addition to other achievements such as development of new modelling softwares and patent filing.

Key Findings

- CEFIPRA has played an important role in strengthening scientific human resource of both India and France. A major criterion followed in project funding is the involvement of young scholars in the project team. It has also encouraged the young scholars to remain actively involved in every stage of the project, undertake exchange visits, and develop competency. .
- In India, top performing institutes in terms of the number of projects have been CSIR (various laboratories under it), IITs, and IISc, whereas, in France most projects have been funded by CNRS associated laboratories, CNRS laboratories and universities. Bilateral collaboration has happened in key disciplinary areas that promote understanding of complex problems of global concern.
- CEFIPRA actively promotes and conducts seminars/workshops in key research areas/sub-areas to help in knowledge exchange. CEFIPRA acts as a forum for identifying promising researchers of both the countries and motivating them to develop joint collaborative projects. In later years, the seminars/workshops have mainly been held in India. As a result of this skewed pattern of location of seminars, the identification of scholars/institutes from France who can jointly take up projects with the Indian team can be effected.
- Continuity is observed in terms of involvement of institutes of

both the countries in CEFIPRA funded projects. This can be seen from the number of joint projects undertaken between them spanning over a period of time. This continuity has helped in taking the problem forward, led to significant outputs, and in some cases translation to economic and/or social outcomes and strengthening linkages among the key institutes of both the countries.

- Domain specific linkages have also been strengthened through CEFIPRA funding. This has created knowledge of significant value in each of the domains. In many cases, it has led to the creation of an institutional setup such as joint laboratories. In other cases, where joint laboratories have been in existence, CEFIPRA funding has strengthened this further. Domain specific linkages are visible in Water, Cancer, among others.
- Majority of the CEFIPRA funding in India are in a few reputed institutions located in major four/five cities. Involvement of institutions from France also shows similar characteristics. This aspect needs attention, i.e., development of a mechanism to identify key researchers/groups in other institutes. Seminars/workshops are an important mode through which CEFIPRA identifies potential collaborators. Holding them in diverse locations may help in the process of broadening the support mechanism of CEFIPRA.
- Response from principal investigators highlights that the major motivation behind submitting the joint projects is to access each other's complementary strength. Flexibility in terms of refining/modifying the problem, and exploring some aspects in more details or in some other way as the project progress are cited as the most promising feature of CEFIPRA's support. Researchers feel constrained when they cannot explore promising leads as they may not form the submitted proposal. CEFIPRA, by allowing this possibility, provides attraction to researchers to approach this organization for support. CEFIPRA follows flexibility in terms of objectives.
- CEFIPRA's involvement in funding industrial projects is a small component of its overall funding. However, important initiatives such as Industrial Research Committee of CEFIPRA in 2001 floated a programme of 'Bridge' projects to ascertain through validation/testing, the feasibility of research ideas at various levels of knowledge generation. Industrial funding has led to promising applications and scaling up of the process to commercial stage. Further, more intensive activity can push this forward. CEFIPRA's new initiatives are in this direction.
- CEFIPRA has taken an initiative to finance collaborative research projects involving academic and industrial partners. The goal is to support different phases of the knowledge innovation chain. For industrial research project demand for industrial centric approach, formulated by the industry with

- more than one industry or one research institution, is possible.
- CEFIPRA funding had led to some important scientific outcomes. For example, in polymer science research, there was a creation of new experimental facilities and exploration of the mechanisms of polymer degradation and stabilization. In cancer research, there was an establishment of a world class cancer research centre in India with sustainable efforts culminating in international recognition. In water research, a

mass balance, energy balance, and hydrological balance monitoring system was induced to monitor Himalayan glacier. In infectious disease research, the search for selective inhibitors of *LiSIR2RP1* has led, for the first time, to the identification of the anti-parasitic bisnaphthalimidopropyl (BNIP) alkyl di- and triamines. In pure and applied chemistry many molecules have been synthesized and are being screened for their biological activities.

4

CEFIPRA: Outputs and Outcomes

Science measurement tools are employed to exhibit an impact of CEFIPRA funded research projects. This is supplemented with content analysis of various documents including feedback of Principal Investigators (PIs) of CEFIPRA funded projects.

Research Publication Activity - Overview of India's Collaboration

One important indication of India's engagement with other countries in research is seen through joint research publications. Table 4.1 gives the number of papers published in India and papers published from international collaboration.

It highlights the fact that joint publications play an important role in India's research volume. Chemistry is India's most active collaborating field as compared to others. France is India's fifth most active scientific partner (based on joint publications) after the United States, Germany, the United Kingdom, and Japan.

Figure 4.1 provides a brief estimation of the joint research publications between India and France from 1940 onwards.

Some aspects show the importance of Indo-French co-authored papers. Year-on-year collaborative papers from India and collaborative papers between India and France are shown in Figure 4.2. It highlights that India's overall international collaboration is increasing, collaboration with France is also exhibiting the same trend, and thus contributing to the overall growth of international collaborative papers.

The share of India and France collaboration in India's total international collaboration was 6.3% (1991–2000), 7.6% (2001–2005), 8.2% (2006–2010), and 8.9% (2011–12).

The percentage of research papers not cited is much less for papers from India-France collaborative papers as compared to overall papers from India. This implies better reception and visibility of collaborative Indo-French papers.

Table 4.1: Number of papers from India in different block years

Block year	Papers published in India	Papers from international collaboration	Percentage
1991-2000	176484	21075	12
2001-2005	123769	21904	17.7
2006-2010	223532	39046	17.5
2011-2012	112297	22434	20

Source: Science citation index expanded (SCI-E)

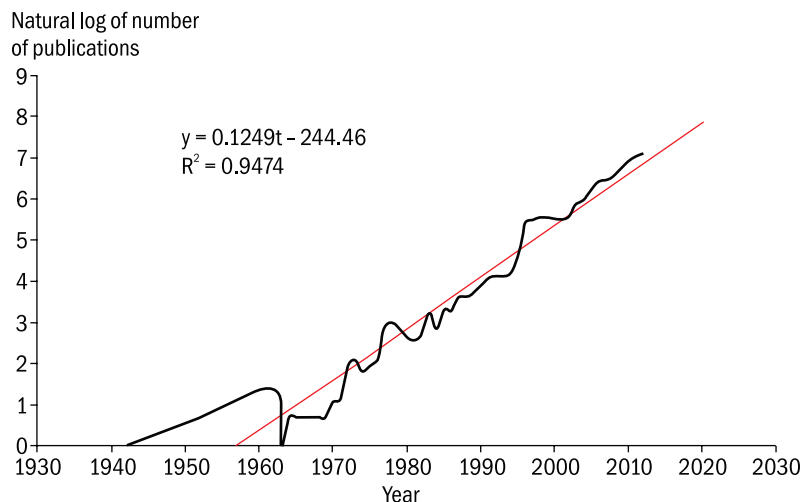


Figure 4.1: Indo-French Joint Publications
Source: Data from Scopus

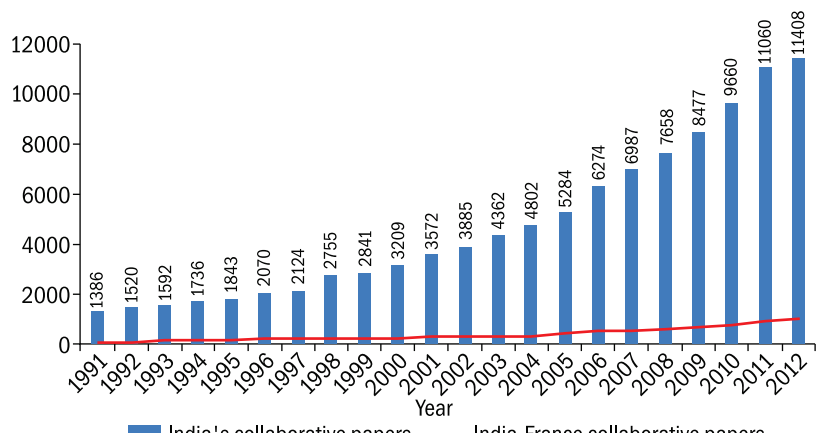


Figure 4.2: Year Wise Trend of Collaborative Papers - India and France
Source: Data from SCI-E

France accounts on an average 1.3% of joint publications year-wise. The number of joint publications with France in major research areas is shown in Table 4.2. The research areas are based on SCI-Expanded subject categorization.

In some research fields, France emerges as the most active research

partner of India. The most active fields of joint research activity are in physics, water resources (third most active collaborating research partner), and mathematics (fourth most active research partner). Using this same database, that is, SCI-E with a different delineation of research fields (delineation based on Essential Science

Table 4.2: Joint Publications between India and France in Research Fields (1990–2012)

Research areas	No. of papers	% Share in total collaborative papers
Microbiology	129	1.5
Pharmacology pharmacy	128	1.5
Plant sciences	115	1.3
Geochemistry Geophysics	112	1.3
Infectious diseases	110	1.3
Meteorology Atmospheric sciences	109	1.3
Metallurgy Metallurgical engineering	104	1.2
Agriculture	97	1.1
Water resources	91	1.1
Spectroscopy	89	1
Cardiovascular system Cardiology	87	1
General internal medicine	80	0.9
Public environmental occupational health	80	0.9
Crystallography	78	0.9
Biophysics	72	0.8
Cell biology	68	0.8
Mechanics	66	0.8
Electrochemistry	57	1
Physics	3277	38.3
Chemistry	1127	13.2
Astronomy astrophysics	844	9.8
Material science	731	8.5
Engineering	436	5.1
Biochemistry Molecular biology	328	3.8
Science Technology Other Topics	286	3.3
Mathematics	276	3.2
Oncology	193	2.2
Computer science	182	2.1
Geology	181	2.1
Optics	151	1.8

Table 4.2: Joint Publications between India and France in Research Fields (1990–2012)

Instruments instrumentation	147	1.7
Nuclear science Technology	147	1.7
Immunology	141	1.6
Genetics Heredity	139	1.6
Biotechnology Applied Microbiology	137	1.6
Polymer Science	136	1.6

Source: Data from SCI-E

Note: Values rounded to first decimal

Indicators classification), evidence (2011) study identified space research, immunology, physics, and geosciences as areas where France emerges among the most active joint publications. Within the major research areas, active sub-areas of Indo–French research collaboration are highlighted in Figure 4.3.

India has a long history of science and technology cooperation with all these five countries. The study examines in detail the Indo–French joint research and innovation activity with particular reference to a bilateral institution IFCPAR/CEFIPRA established between the two countries in 1987. CEFIPRA became functional on

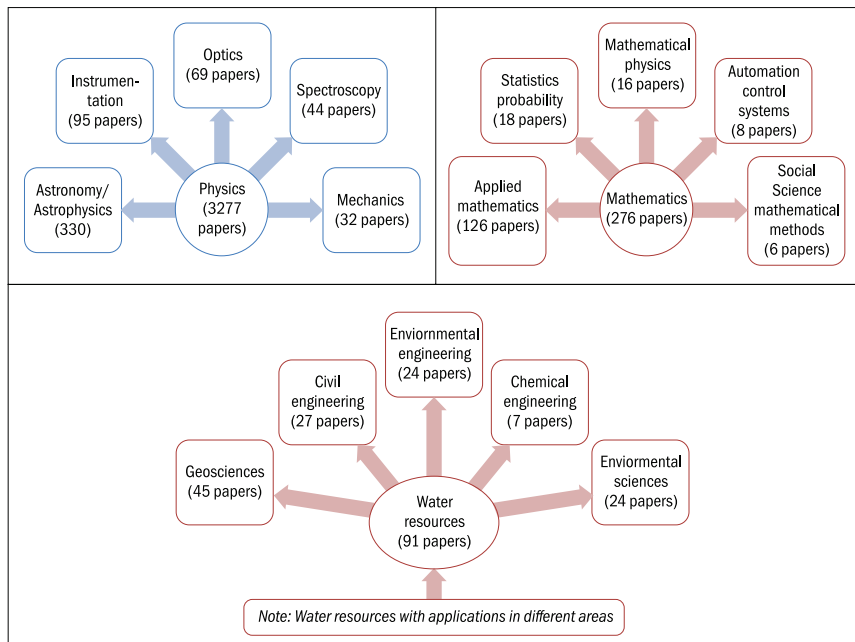


Figure 4.3: Indo–French Active Sub-Areas of Collaboration

Source: Data from SCI-E

September 9, 1987. The publications studied are from the period 1990 to 2009.

Figure 4.4 highlights the role CEFIPRA plays in the overall research collaboration between the two countries.

Papers emerging from CEFIPRA funded projects contribute approximately 17.5% to the collaborative Indo-French research output. CEFIPRA, contribution was maximum in year 1994, accounting for 48% of total collaboration output.

Discipline wise analysis

The 1169 publications from 240 CEFIPRA collaboration projects can be grouped under the following 12 main subjects:

- Biotechnology (Biotech)
- Computer and information science (CIS)
- Earth and planetary sciences (EPS)
- Environmental sciences (ES)
- Life and health sciences (LHS)
- Material sciences (MS)

- Pure and applied chemistry (CHEM)
- Pure and applied mathematics (MATH)
- Pure and applied physics (PHY)
- Information and communication technology (ICT)
- Water (Water)
- Instrumentation (Inst.)

The distribution of projects and publication of research papers under these subject categories are shown in Table 4.3.

Research publications from CEFIPRA projects started from the year 1990 under various disciplines such as material sciences, life and health sciences, computer and information science, and pure and applied fields of chemistry and physics. Consistency can be seen in paper publication of projects under life and health sciences, material sciences, and pure and applied chemistry during 1990–2009.

The projects under instrumentation, published papers only from 1994 to 1998. Publications in fields, such as

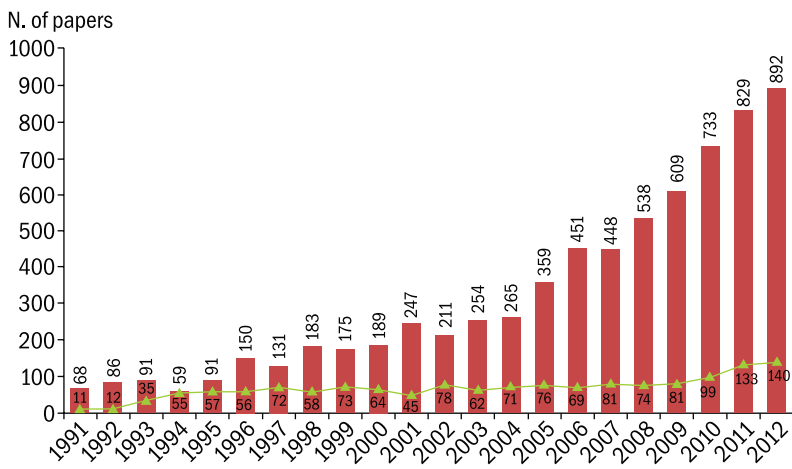


Figure 4.4: Share of CEFIPRA Papers in Indo–French Collaborative Publications
Source: Data from SCI-E

Table 4.3: Publications under subject categories

Subject category	No. of projects	Duration of publication	No. of papers
Biotech	4	2004–2009	9
CIS	12	1990–2007	37
EPS	10	1995–2009	20
ES	5	1999–2009	17
Inst.	2	1994–2009	14
LHS	52	1990–2009	199
MS	43	1990–2009	229
CHEM	43	1990–2009	258
MATH	15	1993–2009	54
PHY	47	1990–2009	294
ICT	3	2004–2009	30
Water	4	2002–2008	8

water, biotechnology, and information and communication technology have started after 2002.

Maximum number of projects are under life and health sciences (52), followed by pure and applied physics (47), material sciences (43), and pure and applied chemistry (43). Project under pure and applied physics

published highest number of papers (294), followed by pure and applied chemistry (258), material sciences (229), and life and health sciences (199).

Quality of research publications is studied on citation received under different subject categories. Table-4.4 shows the citation details of publications from CEFIPRA projects in

Table 4.4: Citation details of publications in different subjects

Subject	Papers	TC	6TC	Avg. TC/ paper	Avg. 6TC/ paper	Avg. TC/year	H-index
Biotech	9	117	117	13.00	13.00	19.50	7
CIS	37	139	83	3.76	2.24	7.72	7
EPS	20	420	205	21.00	10.25	28.00	9
ES	17	293	177	17.24	10.41	26.64	9
Inst.	14	93	51	6.64	3.64	18.60	4
LHS	199	4257	2686	21.39	13.50	212.85	35
MS	229	3868	2083	16.89	9.10	193.40	28
CHEM	258	5031	2943	19.50	11.41	251.55	38
MATH	54	280	149	5.19	2.76	16.47	8
PHY	294	3886	3202	13.22	10.89	194.30	29
ICT	30	206	206	6.87	6.87	34.33	6
Water	8	156	103	19.50	12.88	22.29	4
TOTAL	1169	18746	12005	16.04	10.27	113.61	

different subjects. Total citations (TC) show the citations received for papers till December 2009 from the publication date of paper. Since citations are linked with age of publication, for comparing purpose citations received till sixth year from publication year is considered (6TC). Average citations per paper, average citations received in a year, is also and h-index of each subject field is also shown in the table. These parameters are compared with number of papers to obtain a quantity and quality analysis among different subject projects output. Publications of life and health sciences, biotechnology, and water received an average six year citations (6TC), such as 13.5, 13.0 and 12.88, respectively, than that of other field papers.

It is important to examine research publications emerging from CEFIPRA funded project in an overall context of funded projects. The research publications are important reflections of the output of the projects. The value of the papers (primarily this is seen in this study through citations) testifies to rigorous peer review

process undertaken by CEFIPRA for project funding. The funded projects address areas of cutting edge scientific research problems, areas where scientific research is high in the global agenda (such as proteomics, nanotechnology) or address areas of global challenge (for example, water, environment). Projects draw upon the research competency of the two countries and an underlying motivation that local problems require advanced scientific understanding and technological intervention for proper solution. Figure 4.5 shows the contribution of CEFIPRA in India-France collaborative papers in different subject areas.

Publications emerging from CEFIPRA funded projects show high activity in physics and chemistry. This shows the high activity of overall Indo-French publications in these two fields. However, in some areas the publications emerging from CEFIPRA have high volume in the context of overall Indo-French collaborations. These areas are life and health sciences (45%), information and

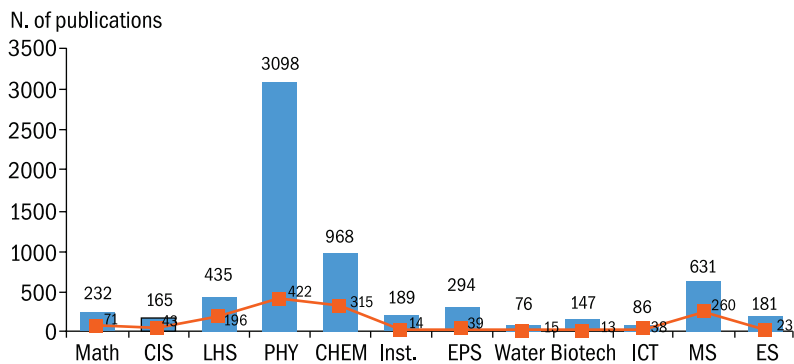


Figure 4.5: Number of publications from CEFIPRA in different subject areas (1991–2012)

Source: SCI-E

communication technology (44%), and material sciences (41%).

The distribution of papers over the years and among different disciplines is given in Table 4.5.

For proper assessment of research activity within each thrust area, publications were normalized by relative weights (RW) as given in Table 4.6. The calculation of weights is done in two ways: Relative weights calculated within a given thrust area (RW1), and within a given year-block (RW 2).

High value of RW1 implies a particular thrust area's high relative activity in that period. For example, CIS and Water produced relatively large number of research papers in 2001–05

than in the other periods. Similarly, low and high values of RW1 can be interpreted.

High value of RW2 implies that a particular thrust area produced more papers relative to other areas in that period. For example, MS had relatively high values in 1991–1995 and 2011–12. This shows better performance of its research paper output than other research fields in these periods. Similarly, low and high values of RW2 can be interpreted. However, the number of research papers in any field is dependent on the number of projects in that field during that period. This dependency also applies to RW1 and RW2.

Table 4.5: Discipline Wise Trend of Papers- CEFIPRA Funded Research (1991–2012)

Discipline	1991–95	1996–2000	2001–2005	2006–2010	2011–2012	Total
MS	96	273	108	90	67	634
PHY	16	114	185	186	26	527
LHS	60	137	164	68	33	462
CHEM	58	156	116	86	13	429
MATH	16	121	66	26	10	239
CIS	26	33	87	9	0	155
EPS	0	51	49	40	6	146
ES	0	8	56	7	7	78
Water	0	0	35	16	1	52
Biotech	0	0	4	30	4	38
ICT	0	0	0	34	0	34
Inst.	0	0	21	0	0	21
Total papers	272	893	891	592	167	2815

Source: Database constructed under this project (papers include SCI covered journals, non-SCI covered journals, and conference proceedings).

Table 4.6: Relative Weights for CEFIPRA Research Publications

Discipline	Heading	1991–1995	1996–2000	2001–2005	2006–2010	2011–2012	Total papers thrust
Material sciences	No. of Papers	96	273	108	90	67	634
	RW1	0.15	0.43	0.17	0.14	0.11	
	RW2	0.35	0.31	0.12	0.15	0.4	
Pure and applied physics	No. of Papers	16	114	185	186	26	527
	RW1	0.03	0.22	0.35	0.35	0.05	
	RW2	0.06	0.13	0.21	0.31	0.16	
Life and health sciences	No. of Papers	60	137	164	68	33	462
	RW1	0.13	0.3	0.35	0.15	0.07	
	RW2	0.22	0.15	0.18	0.11	0.2	
Pure and applied chemistry	No. of Papers	58	156	116	86	13	429
	RW1	0.14	0.36	0.27	0.2	0.03	
	RW2	0.21	0.17	0.13	0.15	0.08	
Pure and applied mathematics	No. of Papers	16	121	66	26	10	239
	RW1	0.07	0.51	0.28	0.11	0.04	
	RW2	0.06	0.14	0.07	0.04	0.06	
Computers and information sciences	No. of Papers	26	33	87	9	0	155
	RW1	0.17	0.21	0.56	0.06	0	
	RW2	0.1	0.04	0.1	0.02	0	
Earth and planetary science	No. of Papers	0	51	49	40	6	146
	RW1	0	0.35	0.34	0.27	0.04	
	RW2	0	0.06	0.05	0.07	0.04	
Environmental science	No. of Papers	0	8	56	7	7	78
	RW1	0	0.1	0.72	0.09	0.09	
	RW2	0	0.01	0.06	0.01	0.04	
Water	No. of Papers	0	0	35	16	1	52
	RW1	0	0	0.67	0.31	0.02	
	RW2	0	0	0.04	0.03	0.01	
Biotechnology	No. of Papers	0	0	4	30	4	38
	RW1	0	0	0.11	0.79	0.11	
	RW2	0	0	0	0.05	0.02	

Table 4.6: Relative Weights for CEFIPRA Research Publications

Discipline	Heading	1991–1995	1996–2000	2001–2005	2006–2010	2011–2012	Total papers thrust
Information and communication technology	No. of Papers	0	0	0	34	0	34
	RW1	0	0	0	1	0	
	RW2	0	0	0	0.06	0	
Instrumentation	No. of Papers	0	0	21	0	0	21
	RW1	0	0	1	0	0	
	RW2	0	0	0.02	0	0	
Total papers		272	893	891	592	167	2815

Note: RW1 denotes the relative weight row wise whereas RW2 denotes the relative weight column wise. Numbers in bold indicate high values. “Information and communication technology” and “Instrumentation” have only occurrence in one period and hence their row values are unity.

Source: Database constructed under this project

Citation wise analysis

Figure 4.6 compares the average citations received by papers emerging from Indo–French joint collaboration and further delineates papers emerging from CEFIPRA.

The average citation received by papers published from CEFIPRA was three (1991–1995), 10 (1996–2000), 20 (2001–2005), and 27 (2006–2009). The overall research collaboration of two countries resulted in average citation of four (1991–1995), 12 (1996–2000), 21 (2001–2005) and 25 (2006–2009).

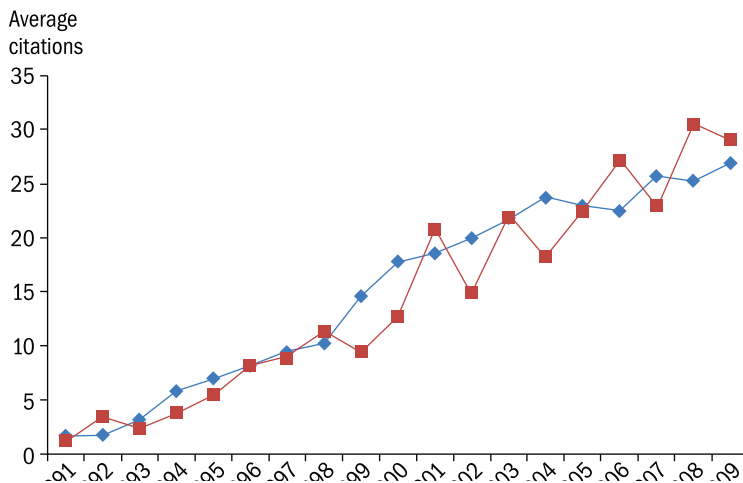


Figure 4.6: Average Citations Received by Papers from CEFIPRA Funded Projects and Indo–French Collaborative Papers

Source: Citations of papers from CEFIPRA funded projects from NISCAIR study

Table 4.7: Average citation received per paper

Avg. C/paper	No. of Projects
>100	3
51–100	7
41–50	6
31–40	8
21–30	28
11–20	46
6–10	47
3–5	41
0–2	54

The latest period is not indicative of the overall reception as citation builds up over the years.

Some papers have made significant global impact, value indication derived from them receive high degree of citations. There are 13 research papers that received more than 100 citations from publications emerging from CEFIPRA funded projects. (Refer Annexure V for details of highly cited papers)

Table 4.8: Distribution of projects on total citations received for its publications

TC	Projects
>500	4
401–500	4
301–400	6
201–300	9
151–200	14
101–150	17
51–100	36
21–50	41
11–20	27
0–10	82

The publications under various projects are studied on citation received to them, that is, total citations received (TC), average citations per paper (Avg. TC), citations received in six years period (6TC), and average citations received per paper in a fixed life time of six years (Avg. 6TC)

Around 98 projects have received more than 10 citations per paper and 24 projects have received more than 30 citations per paper. Tables 4.7, 4.8 and 4.9 provide a brief estimation of the distribution of number of projects on TC, average TC, and average 6TC.

One can get an important indication of value of research publications emerging from Indo–French joint publications and from CEFIPRA funded projects. Indo–French joint publications account for 1.8%, 1.9%, and 2% of papers in 2010, 2011, and 2012 respectively. The importance of these papers can be observed from the presence of a large number of the joint papers in top 1% cited papers from India.

Table 4.9: Distribution of projects on average citations received in 6 years

Avg, 6TC	N.o. of Projects
>100	1
76–100	1
51–75	1
26–50	14
11–25	48
6–10	56
1–5	89
0	30
Total	240

Table 4.10 highlights the percentage of Indo–French collaborative papers and those emerging from CEFIPRA in top 1% cited papers of India. In 2010, 83 papers (10% of the Indo–French joint papers), in 2011, 106 papers (11% of the Indo–French papers), and in 2012, 93 papers (9% of the joint Indo–French papers) are in top 1% cited papers of India. Papers emerging from CEFIPRA are also making impact. In the overall papers from India, in the three respective years that is 2010, 2011, and 2012, the papers from CEFIPRA funded projects are far less than 1% of total India papers. However, 8 papers in 2011 and 2012 emerging from CEFIPRA funded projects are in top 1% cited papers of India. The percentage of Indo–French collaborative papers in top 1% cited papers increased from 45% in 2001–2005 to 56% in 2011–2012. CEFIPRA has significantly contributed towards strengthening this cooperation. Projects emerging from CEFIPRA contributes 10% of the overall Indo–French papers. These papers account for on an average 5% of India's highly cited papers.

Impact Factor wise Analysis

The trend of average impact factor (IF) over the period 1991–2012 is indicated in Figure 4.7. The impact factor curve shows an increasing trend from 1991 to 2012. The research papers have been published in high IF journals from year 1991 onwards. The average IF per paper is increasing over the years, from 1.198 in 1991 to 3.94 in 2012. The lowest average IF per paper is 1.198 in 1991 and the highest is 4.11 in year 2011. The IF of most commonly used journals for publishing papers from CEFIPRA funded projects lay between 2 and 7. We also observed research papers published in journals that are leading journals in their respective fields like Cell, Nature, Science, and Nature Immunology (Refer to Table 4.11 and 4.12).

The average IF per paper has increased over the year that is from 2.555 in year 2001 to 4.0 in 2012. Considering the range of disciplines covered, from mathematics, physics to computers, an IF of more than 4 in years 2010–2012 shows a remarkable accomplishment.

Table 4.10: India - France Collaborative Papers and papers from CEFIPRA in the Top 1% Cited Papers of India

Total number of published papers	Top 1% cited papers		
	2010	2011	2012
India	51212	56168	61547
India-France collaboration	832 (10)	962 (11)	1032 (9)
CEFIPRA funded projects	99 (1)	133 (6)	140 (5.6)

Note: Formulae used to calculate percentage = $\frac{x1}{x} \times 100$

X1 => No. of papers in top 1% cited papers; X=> Total papers

*(%) Percentage of total papers in top 1% cited papers from India

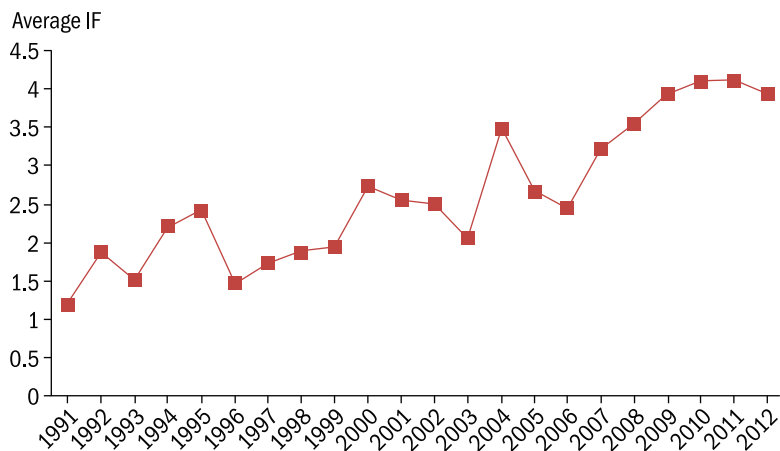


Figure 4.7: Average Impact Factor over the Period 1991-2012 - CEFIPRA

Source: Data captured from SCI-E; Calculations undertaken in this study (2010–2012), 2001–2009 (NISCAIR study)

Table 4.11: Distribution of projects on total impact factor of the journals

Total IF	Projects
>100	1
60–70	2
50–60	4
40–50	7
30–40	11
20–30	16
15–20	17
10–15	29
5–10	64
0–5	89

High citations provide one indication of impact. Analysis of feedback shows how some papers have become very influential in creating new areas of cooperation and deeper engagement. For example, a paper on climate chemistry model as an output of a CEFIPRA project “Aerosols and Indian monsoons” led to the development of a deeper partnership between Indian and French scientists.

Table 4.12: Distribution of projects on Average IF

Avg. IF	Projects
>25	1
11–20	3
6–10	12
3–5	39
1–2	109
<1	17
0	9

A second CEFIPRA project primarily focused on extending this research work. The first author of this paper was a young researcher and had two PI as co-authors. However, unlike citation based analysis, the individual influence of papers through tracing their impact is difficult to capture.

Distribution of publications under various projects

The study covers 240 projects under various subjects and average number of papers per projects comes to 4.9. But there are 93 projects having more than

the average number of publications. Table 4.13 shows the distribution of papers and number of projects.

There are six projects (three in chemistry, one in physics, one in life and health science, and one in information and communication technology) contributed more than 20 papers as mentioned below.

Authorship Analysis

More than 4,000 researchers contributed to 1169 research papers from CEFIPRA projects from 1990 to 2009. The distribution of multi-authored papers is given in Table 4.14. Authorship pattern shows multiple authored papers are more comparing to single author papers.

There are 397 papers authored together by both Indian and French authors. Out of these 397 papers, all principal collaborators of the project participated in 297 papers. Papers with more than 10 authors are in Table 20.

Table 4.13: Distribution of publications under various projects

Research papers	Projects
1	51
2	43
3	34
4	19
5	17
6	14
7	17
8	9
9	7
10	3
11–20	20
> 20	6
Total	240

Table 4.14: Authorship patterns

Authors	Papers
1	50
2	200
3	269
4	347
5	111
6–10	181
>10	11
Total papers	1169

H-Index

CNRS is considered as a single large institute in France contributing the highest numbers of publications. Other major institutions from France contributing papers are UPMC, INSERM, IAP, ENS, and IP. Contributions from India are spread over IISc, CSIR, TIFR, IUCAA, etc. Table 4.15 shows year-on-year citation statistics of CEFIPRA funded projects.

Although the number of papers published from CEFIPRA funded projects are very less in the initial phase (1991–2007), but the average citations received by them are quite high. In the later years, direct relationship with the increase in number of papers can be found with the increase in overall citations.

The h-index moves beyond mere volume to provide a more informed indication of overall influence. Average citation is influenced by one or two highly cited papers. IF attributes quality to a paper based on journal in which it is published. Taking care of these anomalies, h-index shows that at-least this much number of papers have received citations as indicated by *h* value (Table 4.15). Thus the increase in *h* value shows overall influence of

papers emerging from CEFIPRA funded projects are increasing.

Technological Output: An Overview

The publications are one form of output. It primarily captures scientific research outcomes. For assessing the impact of CEFIPRA, the study has examined the technological outputs and outcomes. This includes capturing new algorithms, new software developed, products, process, and designs emerging from

the scientific projects. Of the overall 333 completed projects, 112 projects (34% of the total completed) have produced 143 processes, 22 products, 24 patents filed, and 27 designs.

For 'proper' assessment, three categories of projects were identified. The categories defined in terms of number of projects are high, medium and low quartile. Table 4.16 identifies technological output quartile wise.

Table 4.17 show that process contribution has been dominant

Table 4.15: Papers from CEFIPRA Funded Projects and their Key Citation Statistics*

	1992	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of Papers	1	1	1	1	1	1	29	81	104	137	144
Times Cited	29	7	4	9	14	3	314	1135	816	902	323
Citation per paper	29	7	4	9	14	3	10.8	14.01	7.85	6.58	2.24
h-index	1	1	1	1	1	1	11	18	15	15	8

Source: Data from web-of-science

Note:*Accessed on 1 October 2013. All the papers that have given CEFIPRA as source of funding were captured. This may miss out papers in SCI-E as an output coming from CEFIPRA funded project if the authors have not mentioned CEFIPRA as funding source. Years in which papers are not visible are because papers were not covered by SCI-E.

Table 4.16: Technological Output in Different Thrust Areas

Quartile	Discipline	Patents filed	Product	Process	Design
High	MATH	0	2	6	0
	LHS	4	6	37	1
	PHY	3	2	22	3
	CHEM	4	4	23	6
	MS	11	7	24	8
Medium	CIS	0	0	4	2
	EPS	0	0	11	3
	ES	0	0	3	1
	Biotech	0	0	6	2
	Water	2	1	6	0
Low	Inst.	0	0	0	1
	CIT	0	0	1	0

Source: Database constructed under this project

across thrust areas. In designs MS is the dominant area followed by CHEM.

Apart from the above mentioned projects, some of the studies have led

Table 4.17: Some Major Products, Processes and Designs Emerging out of CEFIPRA Funded Projects

Products			
LHS	Two-component tissue adhesive from biocompatible & biodegradable polysaccharides Human Monoclonal antibodies reactive with rabies virus Inducible chimeric tumour suppressor	MS	3 microstructures (Er,Hm, and TNS3) Polyaniline film with poly (vinyl chloride): An insulating commercial polymer ECD device fabrication with tungstic acid-hydrogen peroxide based WO ₃ coatings Modified window glass system (substrate of thermochromic coatings) Highly textured diamond sheets of large area
CHEM	Micro post column reactors new polymer for microfluidic chip surface treatment	Water	25A (1.5L/hr) capacity electrochemical nitrate removal unit
Processes			
CHEM	New strategy for low cost chip Novel technology proposed for the treatment of Pre Hydrolysis Liquor(PHL) HPLC (High Performance Liquid Chromatography) analytical method for Synthesised new amphiphilic liquid crystalline compounds Comprehensive 2-D model for a totally solute/protein rejecting membrane to explain fouling & predict critical flux	LHS	GFP:gus gene transformation by agrobacterium tumefaciens Developed a multi-copy DNA sequence scanning algorithm (ADAPT) Pest resistant transgenic coffee strain development -By BT gene transformation system Homeotic gene trans-regulation- Fly gene (Alh) exact genetic footprint of Human genes AF10/ AF17 (leukamia) Nystatin Resistance in Ascomulus immerses- MIP(Methylation Induced Premeiotically) Phenomenon
Processes			
MS	Insulating commercial polymer prepared by industrially acceptable methods Controlled chemical & biochemical synthesis of anisotropic magnetic nanostructures and functional nanocomposites Material use for used for energy storage- Transition metal phosphate; CVD (Chemical vapour deposition) of diamond films by Heteroepitaxial Process	Water	Developed an appropriate model of the unsaturated/partially saturated zones in the weathered rock overlying the fractured zone Developed Catalyst PdSn/Al ₂ O ₃ & PdSn/TiO ₂ and nano-electrocatalysts PdSn/Ti & PdAg/Ti and two routes the catalytic & electrocatalytic compared

Table 4.17: Some Major Products, Processes and Designs Emerging out of CEFIPRA Funded Projects

Designs			
CHEM	Design of new photosensitizers based on porphyrin and phthalocyanine core Design and construction of offline post channel reactor at microscale Number of new monochromic SAA have been designed and synthesized	MS	Design of composite gels of polystyrene and oligo(p-phenylenevinylene) (OPV) with improved physical properties Design of composite gels of OPVs and Carbon nanotubes(CNTs) Design of various organogel morphology by toying with end groups and solvent type.

Source: Database constructed under this project; **Note:** Refer Annexure VI, VII and VIII for details of the output

to the influential outcomes uncovering the new facets of sciences thus can give better understanding of different mechanisms. Among these influential research outcomes include:

- (a) The role played by Clag 9 in pathogenesis of malaria, role in cytoadherence properties of the parasite; understanding the biology of chaperon proteins in parasite, essential in developmental transition in the parasite.
- (b) Protein recognition biology, a field of great importance and development of databases to analyse structural and dynamics properties associated with protein-protein complex formation.
- (c) Generation of new electrode materials through soft chemistry reaction.

Figure 4.8 exhibits the distribution (quartile wise) of the number of products/project, patents/project, process/project, and designs/project for various disciplines.

It can be observed that the overall process per project is the highest across all the quartiles. The output of field is dependent on the number of

projects funded under that area. To an extent, category wise distinction helps in the normalization. However, within each category differences can be seen. Another view is obtained by normalizing with the number of projects in a thrust area. This normalization shows that the maximum processes are visible in biotech, water and EPS. Products are limited to few areas that is areas of high quartile, in water and MATH from medium quartile.

CEFIPRA has also funded industrial projects which have resulted in useful outcomes.

Technological Output: Statistical Assessment

Technology Index is a composite indicator constructed to compare the relative technological performance of Thrust areas. Technology outputs covered are processes created, products developed, patents filed, design created, and instrument developed. Equal weight of 1/5 is applied to the frequency of occurrence of each technology output in a thrust area to calculate the overall composite index (Refer End Note and Annexure II for details of construction of this index).

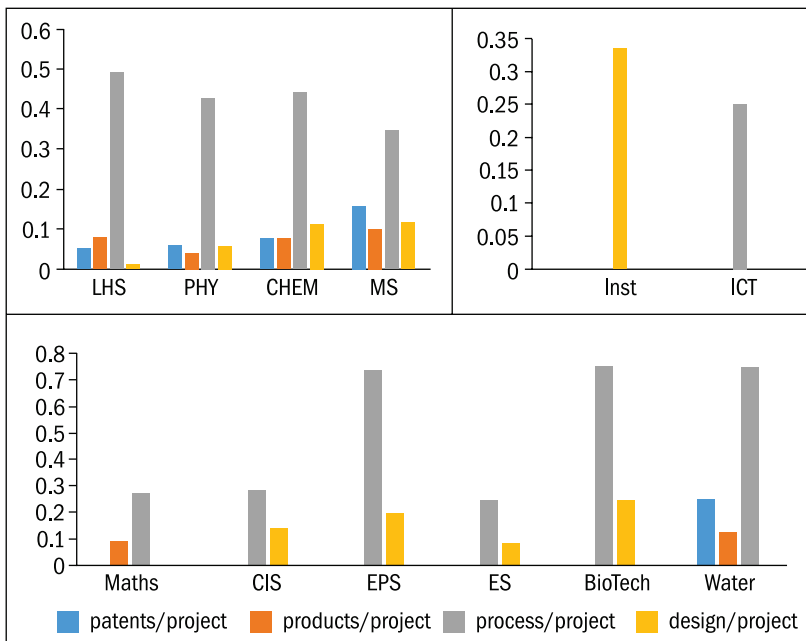


Figure 4.8: Distribution of the Technological Output Quartile-wise

Source: Database constructed under this project

Table 4.18 highlights the results of the technology output index.

As evident from the table that there has been maximum innovative output

in MS (index value = 10.2), followed by LHS (index value = 9.8) indicating the maximum contribution to innovation from high quartile. The trend roughly

Table 4.18: Technology Output Index – Discipline Wise (1987–2012)

High Quartile	No. of Projects	Patents Filed	Product	Process	Design	Instrument	Index Value
MS	69	11	7	24	8	1	10.2
LHS	75	4	6	37	1	1	9.8
CHEM	52	4	4	23	6	0	7.4
PHY	51	3	2	22	3	0	6
Medium Quartile	No. of Projects	Patents Filed	Product	Process	Design	Instrument	Index Value
EPS	15	0	0	11	3	0	2.8
Water	8	2	1	6	0	0	1.8
Biotech	8	0	0	6	2	0	1.6
Medium Quartile		Patents Filed	Product	Process	Design	Instrument	Index Value
CIS	14	0	0	4	2	1	1.4
ES	12	0	0	3	1	0	0.8
Low Quartile		Patents Filed	Product	Process	Design	Instrument	Index Value
Inst.	3	0	0	0	1	0	0.2
ICT	4	0	0	1	0	0	0.2

Source: Database constructed under this project

shows that the volume of the output is in relation with the number of projects.

Within each quartile there is no direct correlation between the technological output and the number of projects. It is notable to observe that the thrust area LHS has lower value of index as compared to index value for MS although LHS has higher number of projects. Similarly as observed within the medium quartile, in mathematics the volume of output is lower as compared to EPS.

When an observation is made between the heterogeneous quartiles it can be observed that the high quartile as a group has a higher volume of output followed by the medium and low quartiles.

Analysis Based on Volume and Value

For assessing the efficiency of the system (system herein means CEFIPRA funding for projects and its capacity of

deliverance), composite indicator was constructed. This index which we call “volume vs. value index”, a composite indicator attempts to capture the relationship between volume (input) and value (output or rate of return). The input is per-capita expenditure in each thrust area of key activities. The value V signifies the weighted value of the output measured in terms of technological output, research publications, and human resource (these are outputs of the CEFIPRA funded projects) (Refer Annexure II for details of the construction of this index).

Figure 4.9 plots value–volume relationship thrust area wise. The horizontal axis that is X-axis implies per capita expenditure in each thrust area, the vertical axis that is Y-axis is rate of return measured as the value index. The size of the bubble implies the absolute value of Expenditure for each Thrust area.

The per capita expenditure (average project cost) is high for ICT with low

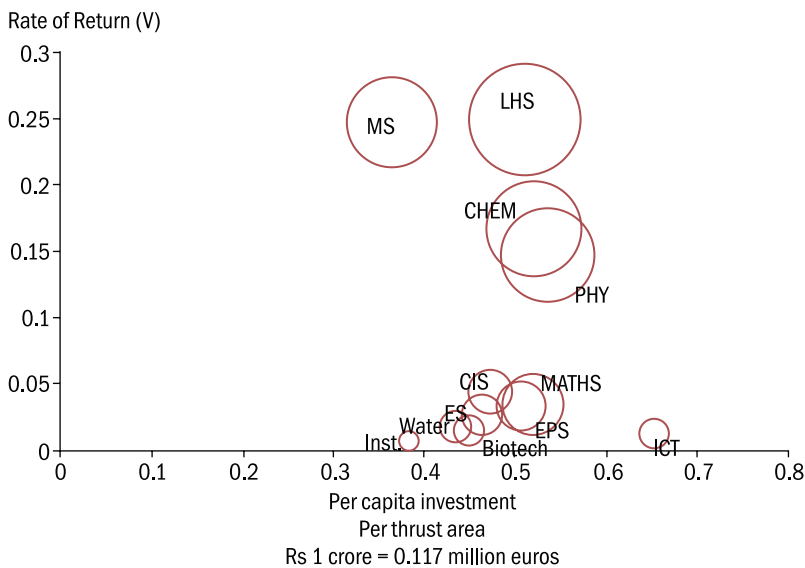


Figure 4.9: Per Capita Investment vs. Rate of Return (Thrust Area Wise)
Note: Size of the bubble is dependent on the total expenditure of a Thrust area

rate of return (weighted output). On the other hand MS has the highest rate of return with average project cost much less than ICT and mathematics. Examining the total expenditure of a thrust area (by size of bubble) and average project cost (by horizontal axis), MS, LHS, PHY, CHEM, and CIS have also shown to perform well.

Key Findings

- India and France have a long history of collaboration in Science and Technology. Joint research publications between these countries can be observed from 1940 onwards. Mathematics, Physics and Chemistry, Metrological Sciences and Space Research has been active areas of research engagements with the two countries.
- Along with advance research areas, areas of developmental concerns like water, infectious diseases, and climate change have also been areas in which researchers from the two countries exhibit active collaboration.
- France is the fifth most active collaborative partner of India accounting for on an average 8% of her international collaborative papers. On an average Indo–French joint papers are 2% of India's overall papers. The joint papers of both the countries show an increasing trend from 2003 onwards, papers approximately doubling every three years from that period.
- The collaborative papers draw attention faster (measured in terms of citations received in the year of paper publication) than India's overall papers. The collaborative papers together account for 2% of India's papers but have 10% presence in India's top 1% cited papers.
- Papers emerging from CEFIPRA funded projects cover the 12 thrust areas and widely distributed across various sub-domains of these major areas. Publication activity in a thrust area shows variations of high and moderate activity.
- Some papers have made significant global impact, value indication derived from their receiving high degree of citations and presence in top 1% of India's cited papers. Some papers have been very influential attracting over 100 citations.
- CEFIPRA covers range of research areas from Mathematics to Water to cutting-edge scientific fields for funding. Citations have significant variation within the research fields. Keeping this in context an average impact factor of 4 that papers from funded projects have year wise provides a good indication of research paper visibility. The h-index of papers published from CEFIPRA funded projects is increasing. This shows that the overall influence of the papers are increasing. Another indication of influence can be seen from key papers that have further contributed to strengthen the research activity.
- Some papers have become very important in creating new areas of cooperation and deeper engagement. For example, a paper

on climate chemistry model as an output of a CEFIPRA project “Aerosols and Indian monsoons” led to the development of a deeper partnership between Indian and French scientists. A second CEFIPRA project primarily focused on extending this research work. The first author of this paper was a young researcher and had two principal investigators as co-authors. The outcome of this work was the identification of primary particles for weather changes. This work has significantly contributed to weather forecasting model in India and at a global level.

- There are variations in research outputs when one takes the total period of study in consideration. In some period, a particular thrust area shows high activity than others. These observation are in the context of completed projects.
- Scientifically funded projects resulted in development of novel processes, products, instruments, and design. Scientific projects completed till 2012 have resulted in 143 processes, 22 products, 24 patents filed, and 27 designs.
- Material sciences is the best performing thrust area with respect to high ‘rate of return’ (output) w.r.t. expenditure given per thrust area.

End Note

Relative Weight

The RW1 of a particular year-block within a particular thrust area is

calculated as, for example in the year block 1991-95 the thrust area material sciences has 96 research publications (refer Table 4.4) and the total number of research publications in the thrust area material sciences for all the year-blocks is 634 (refer Table 4.4) . Thus the relative weight within the thrust area for the year block 1991-95 is $(=96/634=0.15)$. Similar calculations are done for all the years within each thrust area.

The RW2 of a particular thrust area within year-block is calculated as, for example in the year block 1991-95 the thrust area material sciences has 96 publications (refer Table 4.4) and the total number of research publications in the year block 1991-1995 is 272 (refer Table 4.4) . Thus the relative weight within the year block 1991-95 of the thrust area material sciences is $(= 96/272 = 0.35)$.

Technology Output Index

There are five technological outputs i.e., process, product, patent, design, and instrument. The index was constructed to observe the volume of innovative output produced in each thrust area from the projects. An equal weight of 0.2 $(= 1/5)$ is given for the existence of a particular output. For example, if in a project a process exists then it contributes a weight of 1/5 in the calculation of volume of output.

For the calculation of index value; for example if a project has 37 processes and 2 products the calculation of index value is $(37*0.2+2*0.2=7.8)$. It gives a relative index value thrust area wise. (Refer Annexure II for details of construction of the index).

5

Discussion, Conclusion, and Strategic Priorities

Discussion

Scientific research has become highly complex and capital intensive, and requires sophisticated instruments and skilled manpower. It is difficult for any country to have all the resources for addressing the challenges of science. Thus, international research collaboration has emerged as an important instrument for strengthening research capacity and capability of the researchers and institutions in a country. This has motivated governments of various countries to play an influential role in developing international research partnerships.

Science is playing a major role in new industries, that are knowledge driven. Innovation that is development of commercially new products or processes, is increasingly emerging from firms which have a strong interface with the downstream knowledge producers. In this new scenario, international academic cooperation between countries are not restricted only to scientific research but also has to play an effective role in strengthening the innovation ecosystem of both the partner countries. It needs to create value out of their interactions in terms of creating global public goods, find solutions to complex problems of science and technology, address new challenges in emerging technologies, and create

social and economic impact for both the partnering countries. Along with the governments' strong push, factors such as globalization, Internet, and greater mobility of information, ideas, and people are also facilitating international collaboration.

India has appropriately given a high priority for developing international collaboration to strengthen the various stages of the knowledge value chain. The priority has shifted from providing support for strengthening research partnership to a more engaging relationship that attempts to create suitable mechanisms for partnership covering the whole innovation value chain. France has played to be one of the most important partners of India and both the countries have a dynamic and progressing relationship in a large number of areas. Scientific research partnership continues to be an important area in the partnership of the two countries. Many notable achievements can be cited to show the depth and value of the research cooperation between the two countries.

The study has highlighted the historical partnership through research papers, development of joint laboratories in advanced scientific areas as well as in areas of global concerns, development of individuals, and institutional linkages. It can be observed that Indian researchers had

intense engagement in mathematics and various domains of natural sciences covering a long time period. In the last two decades, a strong focus on addressing problems of applied nature such as weather forecasting, advanced materials, infectious diseases, space research, water purification, and climate change can be observed.

An important outcome of the Indo–French collaboration was the establishment of the bilateral institution Indo–French Centre for Promotion of Advanced Research/ Centre Franco-Indien pour la Promotion de la Recherche Avancée (IFCPAR/CEFIPRA) in 1987; it acts as a nodal entity to facilitate collaboration of science and technology between India and France. CEFIPRA has evolved over the years; expanding its role from that of a funding organization to facilitate scientific exchange and joint research in cutting-edge scientific research between the two countries to providing various types of interface mechanisms to support STI between the two countries. CEFIPRA, recently completed its 25 years of existence, has evolved as a fulcrum of science and technology partnership between India and France.

There is a strong desire in both the countries to take this science and technology partnership to a new level that brings in all the different stakeholders covering the innovation value chain. This has led to dynamism in their partnership with efforts being made to bring in industry players from both the countries to engage more actively with academia and research organizations of India and France. One of the major focuses is to reach out to new stakeholders who can help

catalyse the different phases of the innovation cycle.

The report primarily examines the journey of CEFIPRA in the last 25 years; the value it has helped to create and how this will help shape the promising new engagement the two countries are envisaging in STI.

Key Findings

On the basis of examination of various types of data sources, content analysis of feedback from principal investigators, and limited interactions with these investigators, we found that the key aspects that have been underlined for collaboration have been instrumental in forming and forging ahead in the investigated Indo–French collaboration. However, there has been variation in terms of certain aspects being dominant in one project than the other. Primarily, we observe access to expertise and particular skills, access to equipment and resources, cross-fertilization of research across disciplines, improved access to learning and tacit knowledge about techniques, obtaining prestige, visibility or recognition, and enhancing young researcher's skills have all played a role in these collaborations. To what extent each of these factors played a role is beyond the scope of the present study. Further investigations, primarily direct interactions with the population will help us to be more informed of this.

An interesting set of observations, based on the analysis of the feedback, provides indication of the strengths of CEFIPRA's involvement in the Indo–French collaboration. It also points towards some aspects that the researchers have felt have been the

most influential factors and aspects of CEFIPRA's support. Flexibility has been cited amongst the most helpful and motivating aspects of CEFIPRA's funding. Flexibility is defined in terms of administrative or operational flexibility and allowing the researchers to modify the project objective and/or focusing on an important research lead that could have emerged during the course of investigation. Flexibility is not in terms of diluting the academic and/or liberally exploiting funding mechanism. Researchers have cited that this attribute has been very helpful in taking their study forward and has provided them opportunities to deepen their collaborative relationship.

The importance attached to human resource development through the programmes of the Centre has been significant. Through exchange visits for the scholars and investigators, the centre has essentially helped in the growth of knowledge amongst the scholars by sharing knowledge. The primary objective of supporting collaborative research projects between Indian and French scientists is to complement the expertise and strengthen the high quality research groups in advanced areas of science and technology thereby promoting excellence in science.

CEFIPRA has not only led to high scientific activity but has also has expanded its activity horizon. It has evolved over the years and is now a more dynamic organization. The activities of the centre have helped enhance knowledge sharing. Seminars are conducted under various areas ranging from water, monsoon modelling, to nutrition and cancer

studies. Seminars have also been pivotal in scouting for new research proposals and in collaborating for new projects.

CEFIPRA through its support to the collaborative projects has helped establish research linkages between the academic institutions of India and France. In India, top performing institutes in terms of number of projects are IIT, IISc, and CSIR, whereas in France the CNRS associated laboratories, and CNRS laboratories have been actively involved. The linkages have been in a number of fields including those of global concerns such as water, cancer, and environmental sciences. Institutes such as the CSIR–National Geophysical Research Institute (NGRI) for research activity in water, Industrial Toxicology Research Centre (ITRC) for Pharmaceutical research, CSIR–Centre for Cellular and Molecular Biology (CCMB) for cancer research, and King George's Medical College for Infectious Diseases have developed linkages with many institutes of France such as the CNRS laboratories and many other prolific institutes in the country.

An analysis of the city-wise linkage between two countries shows that Bangalore has the highest number of projects supported by CEFIPRA. In the initial years (from 1991–2000), Delhi had the maximum number of CEFIPRA funded projects. On the other hand in France, right from formative years, Paris had the highest concentration of projects as compared to rest of the other cities. Concentration of CEFIPRA projects are skewed in terms of location and mainly restricted to major cities in both the countries. This needs some attention in future as CEFIPRA evolves to become more influential

in synergizing the STI partnership between the two countries.

Research publications are a major outcome of collaborative research projects. India and France have had a long history of collaboration in science and technology. Joint research publications between these countries have been observed since 1940 onwards. Mathematics, physics, chemistry, metrological sciences, and space research have been active areas of research engagements. CEFIPRA covers a range of research areas from mathematics to water to various cutting-edge scientific fields. Along with the advance research areas, issues of development concern such as water, infectious diseases, and climate change have also been prominent with bilateral research. Projects emerging from CEFIPRA contribute around 10% of the overall Indo–French papers, accounting for, on an average, 5% of India’s highly cited papers. The growth of joint Indo–

French papers and CEFIPRA papers are in proportion. Citation reception suggests that few papers of CEFIPRA are very influential. Some papers have led to defining a new problem of domains and initiated further research work of global importance. Citations have significant variation within the research fields. Keeping this in context, an average impact factor of four provides a good indication of reception of research papers emerging from CEFIPRA. Figure 5.1 highlights some major achievements of CEFIPRA.

The content analysis of the feedback provided by the principal investigators gives an overview of the outcomes of the collaborative projects. Moreover, it is substantiated by the accessible statements from the institutes where projects under various objectives were conducted; for example, in polymer science research, there was a creation of new experimental facilities and exploration of the

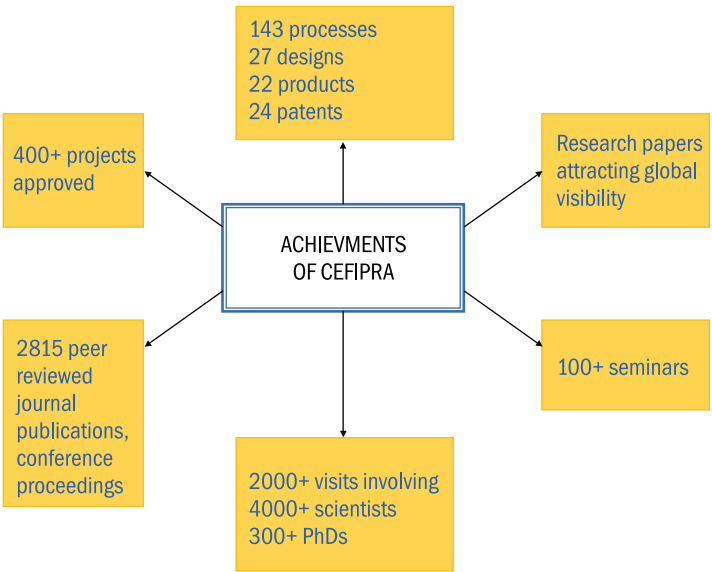


Figure 5.1: Some Major Achievements of CEFIPRA

mechanisms of polymer degradation and stabilization. In cancer research, there was an establishment of a world class cancer research centre in India with sustainable efforts culminating in international recognition. In water research, a mass balance, energy balance, and hydrological balance monitoring system was induced to monitor Himalayan glacier. In the research area of infectious diseases, the search for selective inhibitors of LiSIR2RP1 has led — for the first time — to the identification of the anti-parasitic bisnaphthalimidopropyl (BNIP) alkyl di- and triamines. In pure and applied chemistry, many molecules have been synthesized and are being screened for their biological activities. An International Virtual Electro Magnetic Laboratory (VEML) was set up, with the objective to implement complementary new expertise in natural hazards. This was an outcome of a project funded under earth and planetary sciences.

Another project led to the development of new insights into protein recognition in biology (through systematic studies of known protein–protein complexes), a field of great importance for understanding the normal function and pathologies in all organisms. Development of databases to analyse structural and dynamics' properties associated with the formation of protein–protein complex. Another project led to the development of understanding of ash ponds and factors that have helped to develop fly ash reclamation technology later. This project addressed a major industrial effluent problem and has generated interest particularly in thermal power plants. Implementation can be seen in the Korba Super

Thermal Power Station, India. Figure 5.2 depicts some of the important achievements of the intensive research and development work carried out in the CEFIPRA projects.

New Initiatives

CEFIPRA is creating new engagements to strengthen the "research and innovation" ecosystem of both the countries. It is trying to create a new compact that provides framework for this new engagement. The academia–industry projects, processes developed in partnership with the industry, are some visible outcomes of these new initiatives. The French industries are also showing interest and have opened research and development centres in India. They are acting as a catalyst for this new change in Indo–French scientific cooperation.

Recent MoUs signed between academia and industry partners of both the countries demonstrate a strong commencement. Research MoUs signed between Indian and French institutions; virtual laboratories that were established in important research domains progressed and became effective largely through the role of CEFIPRA in funding research projects, arranging for exchange visits, seminars. The new engagement of CEFIPRA will not be restricted to just developing the research cooperation further but creating a support system that strengthens the academia–industry engagement and innovation ecosystem.

CEFIPRA is already providing a platform to the French and Indian industries in collaboration with research institutions and universities

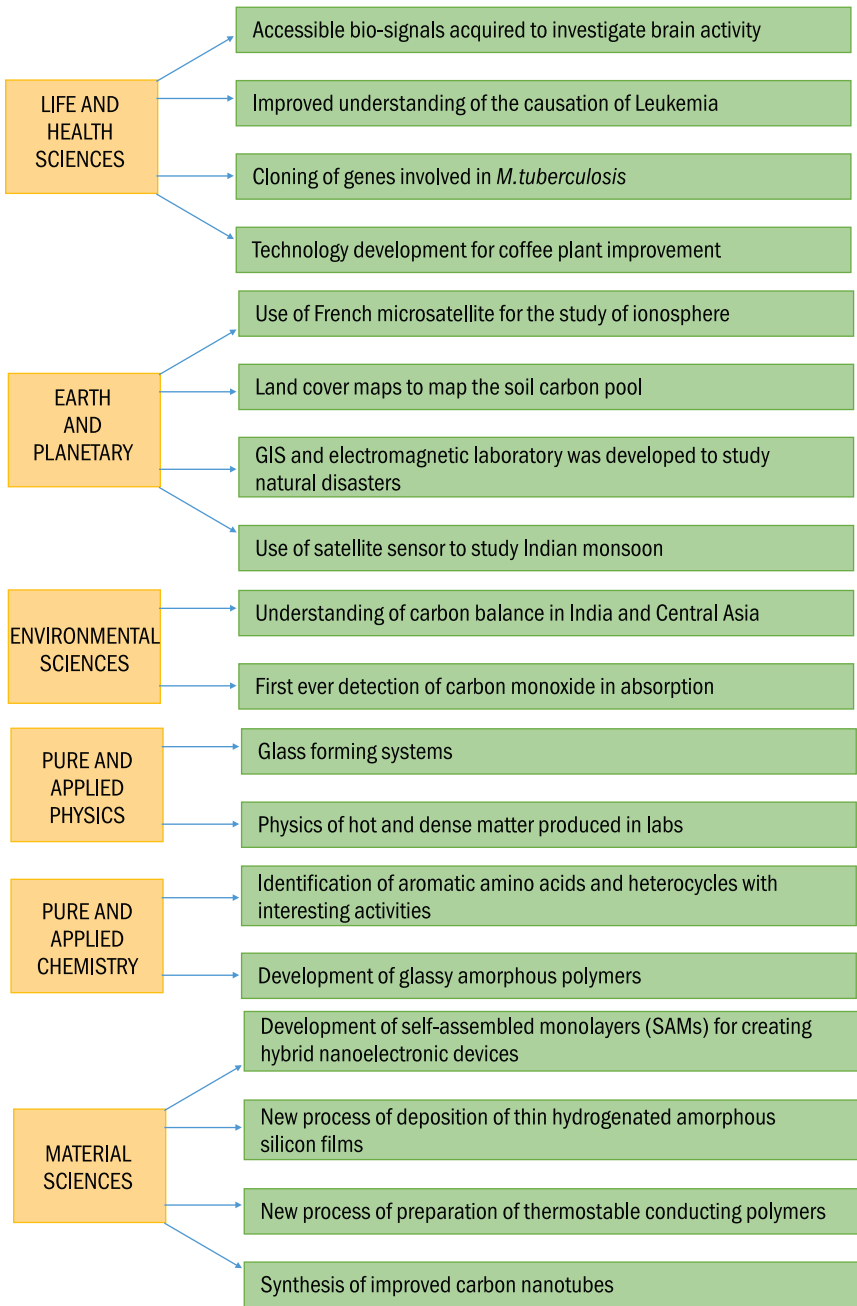


Figure 5.2: Highlights of Achievements in Different Thrust Areas

of both the countries. Program such as "bridge" initiated by CEFIPRA to ascertain through validation or testing, the feasibility of research ideas at various levels of knowledge generation are important steps in this aspect. The academia–industry involvement, funding for industry-oriented projects is already showing significant outcomes. For instance, one product "misoprostol" has already come into the market. Many new enzymes and other materials have been synthesized in addition to other achievements such as development of new modelling softwares. Some of the major new initiatives undertaken by CEFIPRA are:

- CEFIPRA intends to address the whole knowledge value chain and provide a platform for exploiting the knowledge created for social and/or economic goals benefiting both the partner countries. The new logo of CEFIPRA is an expression of this intention.
- CEFIPRA has launched from January 2013 a newsletter "Ensemble". This newsletter is helping CEFIPRA to reach out to the stakeholders and providing a forum for showcasing the value of Indo–French partnership in general and CEFIPRA in particular.
- "Innovation program" a new initiative launched to provide a platform for private sector organizations to contribute to Indo–French STI collaboration. Saint-Gobain Research India Ltd (SGRI) was the first participant which signed a letter of intent with CEFIPRA for creating a new innovation programme called "sustainable habitat for hot and/or humid climate". This would

be a five-year programme in which research will be supported for developing sustainable and affordable building, material solutions, energy-efficient buildings and related topics identified jointly by the two organizations will be covered. Saint-Gobain Post-Doctoral Fellowship will be launched in India to fund 2–3 French scientists to support their research in premier Indian institutes in the identified topics with funding mechanism decided jointly by CEFIPRA and Saint-Gobain.

Looking at this first successful partnership gives a glimpse of how important this new type of engagement will shape in future. It will provide a new source of funding for CEFIPRA, address the whole knowledge chain and with targeted milestones can exploit the knowledge created.

- Human resource development of both the countries has been one of the major objectives of CEFIPRA. In this context, mobility of research scholars so that the students are exposed to the science, technology and innovation environment of the partnering countries, learn from peers, learn new tools and techniques has been strongly encouraged in each funded project. To further strengthen this activity, the Raman-Charpak Fellowship for mobility of doctoral students between the two countries has been launched recently. This fellowship will support bright PhD scholars registered with an Indian or French research or university to

carry out a part of their doctoral research work in France or India.

- CEFIPRA is also providing support to Indian students to participate in European schools. It has helped Indian students in participating in the European School of Nanoscience and Nanotechnology (ESONN) which helped to further strengthen people to people ties between the two nations. These initiatives complement the exchange visits possible for research scholars through projects supported by this centre.
- CEFIPRA is trying to reach out to new stakeholders so that it can play an effective role in exploiting the knowledge base of both the countries and in the process strengthen each others' industries. An intention of this approach can be seen from the meeting CEFIPRA is conducting with SME's in India; exposing them to the opportunities for improving their competence through collaboration with French partners.
- Recognizing the scope and benefits of trans-national regional synergy, CEFIPRA has started the Indo-French region to region cooperation programme. It intends to provide an opportunity to state-level stakeholders in France and India — through the platform provided by CEFIPRA — to exploit complementary capabilities at various stages of the knowledge innovation chain.
- CEFIPRA's role is being increasingly recognized by other European countries. The India-EU joint house for science and innovation

"Journey of CEFIPRA beyond its 25 years is strongly rooted into its experience of 25 years of existence."

Dr Debapriya Dutta

Director CEFIPRA (quoted in Ensemble: Vol. 1(3). May, 2013)

that is being created in India has taken CEFIPRA's institutional model and experience to develop this institution.

- The Indo-French partnership has been further strengthened by the recent visit of French President in India and a large delegate accompanying him which included French Minister of Higher Education and Research. It has given a push to these new initiatives with many being launched during his visit. The setting up of a pavilion at "technology summit 2013" to highlight the success of the Indo-French collaboration and the role CEFIPRA has played in this context is showing how important the Indo—French relationship is becoming in STI.

Conclusion

Key learning

Observations made from the data have given insights which can help the centre to continue to provide their excellent support towards collaborative projects. The centre has kept a detailed repository of research reports and other documents. The centre needs to develop a database that allows for

easier access to these reports. This will help to explore more efficiently the knowledge developed by this institute and capture missing information gaps.

The practice would help overcome the inadequacy of the data — of the current industrial projects. If there is a recurring report which highlights the progress of various projects, the report can be used as a backup documenting the latest development of the projects, in case the project is abandoned. Apart from the progress reports, the completion reports must be a necessity for completion of the project as this will give an insight into the outcomes of the projects in details and there must be a prescribed format for the feedback of principal investigators. There must be a prescribed format for analysing the feedbacks from the scientists.

CEFIPRA which has been instrumental in the collaboration between the scientists of both the countries as a mediating organization has achieved sizeable success. The organization has evolved over 25 years from a mere funding organization to a centre of knowledge creation. The centre continues to actively take forward these efforts and for enhancing achievements goes through a self-evaluating process and incorporates the new ideas and mandates in the new strategies. Although there have been a few seminars held in the field of Science, Technology, and Society (STS), but it has not yet been developed into a particular thrust area by the centre. The centre could also concentrate its funding in this field of research. The linkage analysis could be done in a good way if the lists of French institutes that are collaborating with India through CEFIPRA are updated annually.

Another feature that has been observed is a skewed pattern in terms of their location, that is more seminars are being held in India as compared to France. The seminars, in the future, could be held in a mixed set of locations for the enhancement of research.

The "brainstorming workshop" held at the centre (August, 2013) are engagements which would help the centre to continuously improve its organization and support to the collaborative projects. The workshop concentrated at looking at the centre's achievements and a way forward in the area of knowledge creation. It was observed that some projects have applied for patents but have not been able to get patents either due to lack of funds or other issues. The centre with its capability showcased the good aspects of projects so that the outcomes from collaborative CEFIPRA funded projects could get due recognition.

In this age of information technology, the centre must concentrate to a high extent on projects in the field of data analytics. The DST-INRIA agreement has taken a step in this direction by currently supporting big data, cyber-physical system (including embedded system), and high performance computing. CEFIPRA can use this initiative to strengthen its data analytics programme.

Also as not to lose out on good research projects, the centre needs to be flexible for the duration for which the centre is ready to fund projects. Other issues in terms of environment for the researchers for research in both countries, the centre could help in the organization of support workshops,

one being a workshop or course on language training. It was considered as an important point as for good research communication among scientists.

Strategic Priority

Strategic Priority 1

There has been a long and fruitful relationship between India and France. Over the years the collaboration between the two countries has been expanding. This collaboration is in research, trade, and many other activities. In research, the collaboration ranges in diverse fields such as space, physical and natural sciences, social sciences, etc. The engagement between the two countries is expanding and covering the different aspects of the STI value chain. With this expansion, CEFIPRA as a bilateral organization has to address the scope of these new horizons.

"With increasing intensity of ties between India and France the opportunities of collaboration on science and technology issues have also become more manifest. It is now recognized that the two countries need to join forces to tap the complimenting strengths of their science and technology institutions and human talent to find solutions to the problems faced by their citizens."

Ms Geneviève Fioraso,
Minister for Higher Education
and Research,
Government of France;
Ensemble: Vol. 1(2). March, 2013

Strategic Priority 2

Many CEFIPRA funded scientific projects have high socio-economic value which can be exploited further through dedicated support of CEFIPRA. CEFIPRA needs to closely re-examine their outcomes and bring in other stakeholders such as industrial partners in this process. There is also a need for benchmarking good practices from the projects and institutionalize them.

Strategic Priority 3

CEFIPRA has taken initiative to finance industrial projects, and collaborative research projects involving academia and industrial partners. CEFIPRA is thus trying to address different phases of the knowledge innovation chain. This is an important transition which can strengthen the STI capacity and deliver important socio-economic outcomes. This activity should be strengthened.

Strategic Priority 4

With the changing scope of research, the evaluation criterion needs to change. Parameters of evaluation for industrial projects or new initiatives which CEFIPRA is undertaking requires a different evaluation criterion to be put in place which would differ significantly from the scientific funded.

Strategic Priority 5

CEFIPRA actively promotes or conducts seminars or workshops in key research areas and sub-areas. These are also forums for identifying promising researchers of both the countries and motivating them to develop joint collaborative projects.

In later years the location of seminars/workshops are mainly in India. Efforts should be taken so that these activities also take place in France with the same intensity as otherwise it may affect the knowledge exchange, new ideas coming from French scholars and in proper identification of young researchers of France.

Strategic Priority 6

Continuity has been observed in terms of involvement of institutes of both the countries in CEFIPRA funded projects. As the output and outcome analysis shows, this continuity has helped in taking the problem forward, leading to significant outputs, and in some cases translating to economic and/or social outcomes. However, the concentration is high in few institutions i.e., number of institutes involved in both the countries are few. Efforts are required to make the funding more spread out across institutes in both the countries

Strategic Priority 7

The basic structure of functioning, in terms of operational flexibility, while

funding of scientific projects must not be lost. Response from principal investigators highlight that the major motivation behind submitting the joint projects is to access each other's complementary strength. Flexibility, in terms of modifying the project objective/methodology is cited as the most promising feature of the CEFIPRA support.

Strategic Priority 8

CEFIPRA has taken a number of new initiatives for engaging itself with the different stakeholders that can strengthen the STI of both the countries. Designing a new logo and publishing the newsletter is just a beginning of this new thinking. Funding partnership with Saint-Gobain to support SMEs is another important initiative, to work strongly with the proposed EU–India Innovation house, a major partner in the India–France technology summit, and conduct workshops with SMEs to show new thrust of CEFIPRA. The project recommends that these types of activities should be given high priority.



Annexure I:

Salient findings of previous performance studies of CEFIPRA

Highlights of Performance Audit Committee

Incorporating the suggestions of Audit Committee and recommendations of Audit Report (2000) - CEFIPRA undertook an exercise of bibliometric analysis of 85 projects. This work was entrusted to INSDOC (presently NISCAIR), one of the constituent laboratories of CSIR.

Major Findings from CSIR INSDOC Analysis

For the 432 publications which have appeared in journals from 85 projects, the highest impact factor is 28.8 and the average impact factor of all the publications works out to 1.71. Out of 510 publications (journals, conferences, edited books), 310 publications have received no citation at all and only 69 have received more than 10 citations. The most cited three papers have received 297, 95, and 88 citations, respectively. The committee recognizes the limitation of impact factor and citation analysis as an index of quality of publications. The need was felt to supplement this study by an in depth analysis through peer assessment to determine the final quality of work.

Key Suggestions by Audit Committee:

- Some of the projects have generated output comparable to global standards from both impact factor and citation index points of view, though the average impact factor as well as the number of citations were not commensurate with the high standard of peer review, and the mid-term review etc., of the projects. The Committee strongly recommends that the Scientific Council may hold detailed discussions on the bibliometric analysis and take appropriate actions so that the future projects are of even higher quality.
- CEFIPRA as per the audit report planned to contribute to set up special laboratories as part of initiative of French and Indian Governments.
- The aim was to create institutions to collaborate in selected areas of high technology and/or areas of pressing concerns.
- The first institution created in this direction was a joint research institute on LASERS.

Highlights of CSIR- NISTADS Study (2009)

The bibliometric study by NISTADS investigated the publication output from 239 projects (1998–2007) and examined their impact in terms of impact factor (I F) of the journals, Impact Factor Per Paper (IFPP) and the pattern of citations of the output as seen through Science citation Index-Expanded (SCI-E).

Key Findings of CSIR-NISTADS Study (2009)

- Projects resulted in the publication of 620 journal papers, 74 conference papers, 25 book chapters, and three reports. CEFIPRA projects were funded to 159 institutions (105 French institutions and 64 Indian institutions).
- About 35% projects were sponsored to 10 French institutions; about 64% projects were sponsored to 14 prominent Indian institutions.
- The 620 papers published were scattered over 289 journal titles published by 16 different countries. About 78% of the total papers have appeared in journals published from USA, the UK, and The Netherlands.
- 585 (~ 94%) papers appeared in Web of Science (WOS) indexed journals and the remaining 6% in non-WOS journals.

The analysis of the Impact Factor (IF) of the journals shows that the research output compares well with mainstream scientific pursuit. The mean IFPP for all the disciplines is 2.92. Of all the disciplines, biotechnology has the highest IFPP followed by pure and applied physics, life and health sciences, and pure and applied chemistry.

Highlights of CSIR-NISCAIR Study (2010)

The objective of this bibliometric study was to quantitatively assess the research publication output from CEFIPRA projects during 1990 to 2009. The scientific research output from 240 CEFIPRA projects resulted in 1,371 international research papers in various disciplines. The study gives an overview of research volume based on disciplines, projects and institutions involved and research quality is analyzed using various bibliometric indicators.

Key Findings of NISCAIR study

- During this period, 1169 research publications came out from the funded projects, mainly journal articles (938), proceeding papers

Highlights of CSIR- NISCAIR Study (2010)

(182), review articles (27), notes (13), letters (7), and meeting abstracts (2). The overall publication trend shows an increase over the years.

- The average IF per paper increased over the years i.e., from 2.224 in year 1990 to 3.948 in 2009. The 18,746 citations received in WOS for 1169 research papers. The average is 16 citations per paper.
- The h-Index of CEFIPRA is 61. Among them 27 research papers received more than 100 Citations. There are 24 projects that have received more than 30 citations per paper
- Co-Authorship analysis - More than 4,000 researchers contributed to 1169 research papers from CEFIPRA projects during 1990 to 2009. There were 397 papers authored together by both Indian and French authors.

CEFIPRA's contribution in Indo–French collaborative output - The total scientific papers from Indo–French collaboration research has increased 8.8 times during the study period. The total collaboration output between India and France increased 141% from 114 papers in 2000 to 275 papers in 2009.

Annexure II:

Construction of Indicators

Technology Output Index

Technology Output Index was constructed to properly weigh technological output produced in each thrust area from the projects. Technological output was discerned under five categories: processes created, products developed, patents filed, design created, and instrument developed. For the calculation of the value of the index equal weightage of ($1/5=0.2$) was given for each category of technological output. If a thrust area contributed to the development of 37 processes, 2 products, 2 patents and there were no design or instruments developed from any of the projects in that thrust Area, then the index value for that thrust area was calculated as ($0.2*37+0.2*2+0.2*2=8.2$). The value for each thrust area was calculated similarly.

Volume vs. Value Index

The volume vs. value index was constructed to understand the relationship of input to the output produced. This index captured Volume–Value for the Twelve Thrust areas and ten key subareas identified by the study. There are 333 completed projects till 2012 across 12 thrust areas. The volume is defined as the input provided for the thrust areas and the value (return to investment) is the output

obtained in the thrust areas in relation to the input. The definition of input and output is considered as follows:

- Input in each thrust area: Total expenditure from all the projects in a particular thrust area/sub-area.
 - Output (Return to Investment) in each thrust area is defined as the Value index (Refer Table 1 for Thrust area and Table 2 for Sub-Area)
- Steps followed for defining Value Index:

- 1 Calculate
 Pat_j : Number of patents filed in the j^{th} thrust area;
 $Prod_j$: Number of products in the j^{th} thrust area; Pro_j : Number of Processes in the j^{th} thrust area; Des_j : Number of Designs in the j^{th} thrust area;
 Ins_j : Number of Instruments in the j^{th} thrust area
- 2 N_{Pat} : Total number of patents for all thrust areas; N_{Prod} : Total number of products for all thrust areas; N_{Pro} : Total number of processes for all thrust areas; N_{Des} : Total number of designs for all thrust areas; N_{Ins} : Total number of instruments for all thrust areas
- 3 The Technological index for each thrust area is defined as
- 4 $Techw = [(Pat_j / N_{Pat}) + (Prod_j / N_{Prod}) + (Pro_j / N_{Pro}) + (Des_j / N_{Des}) + (Ins_j / N_{Ins})] / 5$

- 5 Pub_j: Number of publications in the jth thrust area
- 6 NPub: Total number of publications for all thrust areas
- 7 HR_j: Number of human resource (project research staff) in the jth thrust area
- 8 NHR: Total human resource (project research staff) for all thrust areas
- 8 AC_j: (Sum of average citation for the jth thrust area) / (Total average citation for all the thrust areas)

The Value Index for each thrust area is defined as:

$$V = \text{Tech}_w * 0.3 + (\text{Pub}_j / \text{N}_{\text{Pub}}) * 0.25 + \text{AC}_j * 0.25 + 0.2 * (\text{HR}_j / \text{N}_{\text{HR}})$$

The value V signifies the weighted value of the output measured in terms of technological output, research publications, and human resource as outputs of the CEFIPRA funded projects. The weights are decided based on the activities of CEFIPRA. CEFIPRA has been funding more scientific research and thus, a higher weight is given to scientific research as compared to technological output and human resource.

Table 1: Calculations for Volume vs. Value Index for Thrust Areas

Discipline	Prj	Pf	Prd	Process	Dsgn	Inst	Papr	Pub/ NPub	HR/ NHR	Av.C	Avg_cit/ total_ citation	Tech	VI	Exp. (α)	/Cap Exp.
MS	68	11	7	24	8	1	351	0.2	225	0.257	738.4	0.1	0	0.2	0.364
CHEM	53	4	4	25	6	0	219	0.2	189	0.216	796.9	0.2	0	0.2	0.52
PHY	51	3	2	22	3	0	327	0.2	91	0.104	787.3	0.2	0	0.1	0.536
LHS	74	4	6	35	1	1	249	0.2	229	0.262	1789	0.4	0	0.2	0.51
Math	22	0	2	6	0	0	95	0.1	13	0.015	144.4	0	0	0	0.518
EPS	15	0	0	11	3	0	34	0	24	0.027	208.3	0	0	0	0.505
ES	11	0	0	3	1	0	30	0	34	0.039	197.9	0	0	0	0.463
CIS	13	0	0	4	2	1	59	0	25	0.029	44.6	0	0	0	0.472
Water	7	1	1	4	0	0	12	0	17	0.019	100.1	0	0	0	0.434
Bio- technology	6	0	0	5	2	0	8	0	8	0.009	104.2	0	0	0	0.449
Instru- mentation	3	0	0	0	1	0	9	0	12	0.014	12	0	0	0	0.383
ICT	4	0	0	1	0	0	51	0	7	0.008	55.1	0	0	0	0.652
		NPat	NProd	NPro	NDes	NIns	NPub		NHR		Tot_cit				
		23	22	140	27	3	1444		874		4978				

Note: Number of projects (Prj.), Patents filed (Pf), Product (Prd.), Design (Dsgn), Instruments (Inst.), Paper (Ppr), Human resource (HR), Average citation (Av.C), Value index (VI), Expenditure (Exp.), Per capita expenditure (/Cap Exp.)

Annexure III:

Details of Achievements from projects¹

Biotechnology			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
2700-B1	Dr Anand Kumar Bachhawat, Institute of Microbial Technology, Chandigarh	Prof Serge Delrot, University of Poitiers, Poitiers	Characterized the glutathione homeostasis and stress tolerance from yeasts and plants.
3200-B1	Prof. D. Loganathan, Department of Chemistry, IIT Madras, Chennai	Dr Anne Imberty, CERMAV-CNRS, Grenoble	The project on neutron crystallography of models of N-glycoprotein linkage resulted in the determination of the correct localization of hydrogen atoms, therefore confirming the occurrence of trifurcated hydrogen bonds and establishing the role of hydrophobic contacts.

Cancer			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
4503-2	Dr Vikram Mathews. Christian Medical College Vellore	Dr Christine Chomienne and team	Explored the role of the innate and adaptive immune system and its role in maintaining durable remission in this clinical condition.
2004-1	Bala Nagarajan Cancer Institute - Chennai		Analyzed polar and lipophilic adducts and found that the levels of adducts formed were independent of severity of disease status. 8 oxod G could be used as a marker to reflect patients' potential to fix the lesion and response to radiation therapy.

¹ Based on perception (feedback form) from Project Investigators of CEFIPRA funded projects.

Pure and Applied Chemistry			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
3405-1	Prof. Tanmaya Pathak Indian Institute of Technology Kharagpur	Jean-Luc Decout UMR 5063 CNRS/ University Joseph Fourier- Grenoble I	It was found that the resulting PNA aminoglucosamine conjugate is stable under acidic condition efficiently taken up by the human cells and fairly distributed in both cytosol and nucleus without endosomal entrapment.
3800	Dr S. Vasudevan, Principal Scientist, CSIR-CECRI Karaikudi	Dr Florence Epron, University of Poitiers, Poitiers, France	Highest active and selective catalysts PdSn α Al ₂ O ₃ and PdSnTiO ₂ to N ₂ were prepared. Superior nano-electrocatalysts PdSn/Ti and PdAg/Ti were developed for the direct electrochemical reduction of NO ₃ ⁻ to N ₂ . Developed a 25A (1.5L/hr) capacity electrochemical nitrate removal unit to treat 1000ppm of nitrate contaminated water. An electrocoagulation process (0.5L/hr) was developed for nitrate removal without intermediates.
3805-1	Dr Anil Kumar National Chemical Laboratory Pune	Dr Yves Queneau Institut de Chimie et Biochimie Moléculaires et Supramoléculaires (ICBMS), Lyon,	Have launched their first collaborative project at the frontier of synthetic and physical chemistry, dealing with the use of new media such as ionic liquids for carbohydrate chemistry.
3405-3	Prof. E. Arunan Indian Institute of Science, Bangalore	Prof. Bertrand Rowe University of Rennes, France	A new high enthalpy flow reactor to do high temperature kinetics was built in University of Rennes. This helped in detailed investigation of soot particles formed in acetylene pyrolysis (Carbon 49, 3295 (2009)) and also kinetics parameters for CN + hydrocarbon reaction at very high temperature for the first time (Int. J. Chem. Kinetics in press 2012).
3405-1	Prof. Tanmaya Pathak Indian Institute of Technology Kharagpur	Prof. Jean-Luc Decout Department of Molecular Pharmacochemistry UMR 5063 CNRS/ University Joseph Fourier Bât. E, 470 rue de la Chimie, F-38041 Grenoble Cedex 9, France	During the course of this study a large number of modified monosaccharides and aminonucleosides have been generated which are yet to be screened for their biological activities. Methods are also available for the synthesis of more complex molecules by combining different carbohydrates or carbohydrates and nucleosides.

Pure and Applied Chemistry			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
2805-1	Prof. Prashant Kumar Bhattacharya, Indian Institute of Technology, Kanpur	Prof. Gilbert Marcel Rios, Dy-Director Institut Europeendes Membranes UMR 5635 - CC047 - Place E.Bataillon F 34095 Montpellier cedex 5 (France)	A novel technology combining biochemical degradation and membrane separations has been proposed for the treatment of pre-hydrolysis liquor (PHL). A new model was developed based on pore-plugging theory in order to assess the performance of UF, which clearly showed the reduction in pore-plugging phenomenon as a result of membrane rotation.
3405-2	Dr.Vasundhara Singh, PEC University of Technology, Chandigarh	Dr.Michel Vaultier, Research Director at C.N.R.S., University of Rennes 1, UMR CNRS 6510, Avenue du Général Leclerc, 35042 Rennes Cedex, France	The project, has been successful at opening new possibilities to immobilise catalysts in inorganic matrixes such as clays and heterogenize homogeneous catalysts. This allowed their use in fixed bed reactors for continuous flow chemistry thus opening the door towards process intensification.
7113	Dr Lakshmi Kantam, IITC, Hyderabad,	Dr Michel Vaultier, ISM, University of Bordeaux1	The objective of this project was to develop a green process (eco-friendly) for the manufacture of 2,4-dichloro-5-fluoro acetophenone(DCFA), starting raw material for the manufacture of Ciproflaxin hydrochloride which is a broad-spectrum antibiotic of fluoroquinoline derivatives used to treat patients with broad range of infections.
3205-1	Prof. K.N.Ganesh National Chemical Laboratory Pune	Prof.B.Lebieu, Group leader UMR 5235 CNRS, Université Montpellier 2	The insertion of cationic charges at several positions within the PNA sequence leading to conformationally-constrained analogs and the chemical conjugation of unmodified PNAs to cationic (since arginine-rich) peptidic delivery vectors named CPPs (cell penetrating peptides).
3705-2		ALBERTO Bianco UPR 9021, CNRS, Immunologie et Chimie Thérapeutiques, Institut de Biologie Moléculaire et Cellulaire, Strasbourg, France	Designed and developed the first examples of covalent functionalization of carbon nanotubes (CNTs) with nucleobases. Obtained well-aligned CNTs. We were able to observe the horizontal alignment of CNTs functionalized with adenine. Reported new cationic carbon nanotubes based on polyamines for the development of advanced systems for the delivery and/or modulation of nucleic acid.

Earth and Planetary Sciences			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
3407-1	Prof. Ramesh Singh and Prof. Rajiv Sinha, IIT Kanpur	Jacques Zlotnicki Observatoire de Physique du Globe de Clermont-Fd, France Laboratoire Magmas et Volcans	Based on this project an International Virtual ElectroMagnetic Laboratory (VEML) was set, with the objectives to implement complementary new expertise in Natural Hazards.
2807-1	Barkatullah University in India	LPC2E in France	Correlation of Total Electron Content perturbations linked with seismic activity has been found. The ionospheric sounding data has been used to correlate the ionospheric perturbation linked to seismic activity
4057-1	Prof Asoke Sen Indian team: Prof Ranjan Gupta, Postdoc Rakesh Rai	Dr Robert Botet French team: Dr Edith Hadamcik, Prof Anny-Chantal Levasseur-Regourd	Direct and polarimetric observations of comet 78P/Gehrels, comet C/2009P1(Garradd) and comet 103P/Hartley, at several phase angles and wavelengths. Obtained a set of fully-controlled data about polarized-light scattering by three cometary comae dust particles.
3907-1	Indian Institute of Tropical Meteorology, Pune	Laboratoire d'Océanographie et du Climat: Expérimentation et Approches Numériques (LOCEAN-IPSL, Paris France)	The impact of diurnal SST coupling and ocean vertical resolution on the simulation of ISM and its relationships with El Niño-Southern Oscillation (ENSO) events in a CGCM has been clearly demonstrated by analysing four long integrations of SINTEX-F2, differing only by the frequency of Sea Surface Temperature (SST) coupling (2 vs 24 hours coupling) and/or the vertical resolution (31 vs 301 levels) in the ocean component of the CGCM.
2007-1	Dr John Philip Homi-Bhabha National Institute (HBNI) Indira Gandhi Centre for Atomic Research, T.N., India	Oliver Mondain-Monval	Developed a new non-destructive technique for detection of defects in ferromagnetic materials. Performed a unique Cryo-freeze fracture experiment at CRPP that revealed microscopic evidence for polymer-surfactant complexation at liquid interfaces.

Environmental Sciences			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
3009-1	Dr.Rohini Balakrishnan, Indian Institute of Science, Bangalore, India	Dr.Laure Desutter Grandcolas, Muséum national d' Histoire naturelle, Paris	Recording and characterization of acoustic signals of 25 Grylline species. Taxonomic analyses of the collected specimens using external and internal morphology. Generation of a global phylogeny of the subfamily Gryllinae based on morphological characters. Phylogenetic analysis and song evolution in the grylline genus <i>Itaropsis</i> using a combination of molecular, morphological and acoustic analyses. Analysis of the phenotypic and behavioural variation in the grylline genus <i>Phonarellus</i> , and of its consequences for cricket taxonomy and speciation
2909-1	Dr K.M. Nair NBSSandLUP (ICAR) Hebbal Bangalore	-----	The project aimed at developing a tool to assess the impact of land use changes on SOC stocks for a large area (ca 85,000 km ²) and in terms of biodiversity.
7114	-----	Benjamin Guinot	To develop, test and build an integrated prototype able to convert maps of aerosols from optical density into mass concentration (µg/m ³), which is the only unit that air quality managers handle when dealing with aerosols.
1911-2	Prof. O.P.Sharma IIT Delhi	Prof. P Morel and late Prof. A Berroir, Laboratoire de Meteorologie Dynamique	The Monsoon General Circulation Model served as one of the benchmarks for the purchase of the 1st Supercomputer for weather forecasting of Indian monsoons by the Department of Science and Technology, Government of India. The climate-chemistry model developed under this project was used to investigate the connection between clouds and the cosmic rays. An ion-induced nucleation parameterization was implemented in the model and it was found that the primary particles played an important role in the indirect radiative forcing.

Environmental Sciences			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
3809-1	Prof. B.V.S. Viswanadham, Professor, Department of Civil Engineering, IIT Bombay	Prof. Jean-Pierre Gourc, LTHE, University of Joseph Fourier 1, Grenoble	Demonstrates the use of centrifuge model testing to understand the hydro-mechanical behaviour of landfill cover barriers at the onset of differential settlement. The study demonstrates the application of Digital Image Cross-Correlation (DIC) technique to measure the deformation and strain in soil. An attempt has also been made to bring-out the efficacy of fiber reinforcement in restraining gas flow through soil barrier material at the onset of distortion.
4107-1	HC Upadhyaya, Centre for Atmospheric Sciences, Indian Institute of Technology, New Delhi	-----	Monsoon General Circulation Model was redesigned as LMDZ and made highly sophisticated for implementation on supercomputers at LMD and it is unique among the global models with its capability to "zoom" over a region of interest.
7114	-----	J.E.Leon	The project aimed at developing and validating an operational protocol allowing real time and dynamic mapping of particulate pollution using LIDAR quantitative indicators in the vicinity of intense particulate matter sources.
7109	Kumaraguru College of Technology	National Institute for Agronomic Research and Laboratory for Environmental Biotechnology	Two main parts were developed in the project (Optimization of an anaerobic fixed bed reactor). The first part aimed at evaluating the best material for the inert carrier and the second part aimed at designing the optimal shape of the carrier for our application.

Instrumentation			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
3705-1	S.Chandrasekarn Indian Institute of Science, Bangalore	Dr.Daniele Bonnet-Delpon, Chatenay-Malabry	To explore some new work on design and synthesis of mesoporous materials and their applications in organic synthesis.
1106-2	Dr S. D. Samant, UDCT, Mumbai, Dr.B.M.Choudar-y, CSIR-IICT-Hyderabad, Dr M. Lakshmi Kantam, CSIR-IICT-Hyderabad,	Prof. F. Figueras,IRC-CNRS, Villeurbanne, France	The substitution of liquid acids and bases by solids as catalysts in organic reactions is a requisite for a better preservation of environment. Many solid acids have been discovered and applied in the context of refining, for instance zeolites, clays, mixed oxides or sulfates.
7105	Dr.B.M.Choudhary, CSIR-IICT-Hyderabad, Dr M. Lakshmi Kantam	Prof. F. Figueras,IRC-CNRS, Villeurbanne, France	Developed a process to prepare p-aminophenol from nitrobenzene in single step by using a mechanical mixture of Pt/C and solid acid catalyst. Developed a process to prepare p-aminophenol using solid acid catalyst and acetic acid.
7113	Dr M. Lakshmi Kantam, CSIR-IICT-Hyderabad and Dr.Pravin R.Likhar ; Dr.K.Rajender Reddy (Co-Investigator), CSIR- IICT, Hyderabad, India.	Dr.Michel Vaultier, ISM, University of Bordeaux, France.	Objective of the project is to develop a green process (eco-friendly) for the manufacture of 2, 4- dichloro-5-fluoro acetophenone (DCFA), a starting raw material for the manufacture of Ciprofloxacin hydrochloride.

Life And Health Sciences			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
2903-2	Dr Utpal Bhadra Centre for Cellular and Molecular Biology Hyderabad,	Dr Giacomo Cavalli CNRS, Institut de Génétique Humaine-UPR 1142 - 141, rue de la Cardonille, Montpellier, Cedex 5,	Identified a relationship between cosuppression and pairing sensitive silencing, and collaboration between RNAi components and Polycomb proteins in cosuppression. Characterized DNA sequences mediating pairing-sensitive repression (PSR) and cosuppression. Identified the role of nuclear compartmentalization in inducing PSR and cosuppression.

Life And Health Sciences			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
7105	Shiv Ashish, Near Lathia Rubber Factory Mumbai		Worked on new Eco Friendly Process for manufacturing of another bulk drug intermediate p-Amino Phenol (PAP).
3803-3	Dr.Shyamala Mani	Dr.Pierre Gressens	Studied the developing of human brain in India, rostral to caudal. In France, injecting neuroprotective compounds in mice.
1603-1	Prof. Pradip Sinha Devi Ahilya University Indore	Dr Jean-Maurice Dura Institut de Genetique Humaine Montpellier	Investigations culminated in the molecular cloning and characterization of a novel gene <i>Alhambra</i> , <i>Alh</i> displaying characteristics of repressors of homeotic gene. <i>Alh</i> shows homology to human AF10/AF17 protein, which has been implicated in acute leukemia
3403-4		Pr Marie-Aleth Lacaille-Dubois, University of Burgundy, Dijon	The specific objectives were: Isolation and purification of various saponins present in the roots of <i>C. borivilianum</i> , assessment of cytotoxic and insecticidal activities of the crude, fractionated and purified saponins, development of HPLC method for saponin profiling of <i>C. borivilianum</i> roots. Identification of ecotypes / chemotypes of <i>C. borivilianum</i> growing in India, and Phytopharmacological study of <i>C. orchidastrum</i> , <i>C. borivilianum</i> variety MCB 405 from Mandsaur, <i>C. glaucoides</i> and <i>C. kolhapurensis</i> wild in India.
2903-1	Dr LSShashidhara	Dr Stéphane Noselli	Proposed objective was to study mechanisms of interactions between squamous and columnar epithelia during development, growth and cancer.

Life And Health Sciences			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
--	Central Silk Board Sericulture Station in Hindupur (Andhra Pradesh)	Prof. Pierre Couble, CNRS Research Director Centre de Génétique et de Physiologie Moléculaires et Cellulaires UMR 5534 du CNRS et de l'UCBL1 Villeurbanne, France	Back-crosses and inbreeding strategies led to create a pure strain that survives and reproduces successfully in the presence of the virus, with the same properties of the original commercial line.
3808-3		Dr Ludger Johannes Institut Curie UMR144 CNRS 26 rue d'Ulm 75248 Paris Cedex 05 France	Discovery of retrograde trafficking between early endosomes and the golgi apparatus, and the demonstration that protein-induced glycosphingolipid clustering acts as a driving force for membrane invagination in clathrin-independent endocytosis.

Material Sciences			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
4608-2	Prof. U. V. Varadaraju, IIT Hyderabad, India	Dr V. Pralong, Crismat Caen, France CNRS senior scientist	Prepared a new form of LiNbO ₃ with a lamellar structure from the topotactic reaction between CuNbO ₃ and a molten salt corresponding to the low temperature eutectic "LiCl/LiNO ₃ ."
7108	Prof. P. Chaudhuri, Energy Research Unit (ERU) of the Indian Association for the Cultivation of Science Kolkata,	Prof. C. Longeaud, Laboratoire de Génie Electrique de Paris (LGEP, Gif sur Yvette	Measured the conversion efficiencies of three (2 by Ar-dilution and 1 by standard H ₂ dilution) batches in a testing lab at France and at the lab of IACS.
1808-1	Prof. L. C. Gupta, T. I. F. R. (India)	Dr C. Godart, C. N. R. S.	The quaternary borocarbide series RNi ₂ B ₂ C have been studied extensively in the project and several phenomena associated with the interplay of superconductivity and magnetism have been observed.

Material Sciences			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
1408-2 3508/1	Dr Gopu Kumar Prof. U. V. Varadaraju, IIT Madras	Prof.C.Julian, Department of Heterogeneous, University for Pierre and Marie Curie, Paris, France	The main objective of the project was to develop new cathode materials. The project objectives were very well accomplished and lithium ion cells of 4V were realized as envisaged. Lithium insertion in two nanocrystalline forms of Ti2O5, brookite and rutile, and in nanocrystalline pseudo brookite MgTi2O5. Discovery of a new layered protonic conductor Mn(H2PO4)2. Lithium intercalation in Ti(HPO4) and VOMoO4 and in WNb12O33. Discovery of a new form of LiNbO3 with a layered structure showing reversible Li intercalation. Discovery of a new route to electrode materials using the monoclinic iron hydroxysulphate.
3608-3	Dr Shrikant V Joshi International Advanced Research Centre for Powder Metallurgy and New Materials, (ARCI), Hyderabad,	Dr Christophe L. Martin Grenoble-INP, Laboratoire SIMAP Groupe GPM2, Domaine Universitaire, BP 46 38402 Saint Martin d'Heres Cedex, France	The main achievement of this project was a better understanding of the physical mechanisms at play during the compaction of submicronic powders.
3108-1	Prof. A. K. Sood in Bangalore	Prof. A.Revcolevschi, Paris University of Orsay	Worked in the field of frustrated magnetism, crystal growth and crystallography, physics instrumentation, especially in Raman scattering and other optical properties studies.
2208-1	-----	Henri Alloul	Studied the T dependence of the magnetic correlation length obtained from various approaches.

Material Sciences			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
3408-2	Dr S. Yashonath, Indian Institute of Science, Bangalore	Dr H. Jobic, IRCELYON, CNRS, 2, Avenue Albert Einstein, 69626 Villeurbanne, France.	Studies on pentane isomers in NaY zeolite provide the first direct experimental verification of the well known Levitation Effect. Methane in zeolite NaY exhibits an anomalous maximum in self-diffusivity as a function of loading. Branched isomers in general will have higher self-diffusivity than the linear isomer in 12-ring zeolites.

Technology for Information and Communication			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
4100-IT-1	Dr Dipankar Nagchoudhuri	-----	The collaborative project was on Double Gate structures with DAIICT focusing more on the development of Analog circuits. Several analog circuits using Double Gate CMOS structures were developed. One of them was the Low Voltage Linear Gain Control circuit.
4200-IT-1	Prof. Sivaji Bandyopadhyay Jadavpur University Kolkata	Professor Dr Patrick Saint Dizier Principal Collaborator, CNRS- Institut De Recherche En Informatique De Toulouse, Toulouse, France.	The following focused areas were identified: Querying – for procedural, causal, comparative and evaluative questions, Responding cooperatively and intelligently – to develop data fusion and basic text integration techniques, summarization techniques to provide a synthetic answer and investigate the use of navigation tools so that users can navigate in documents Multilingual aspects – to reuse or adapt to existing resources for handling the multilingual aspects Applications, implementation and testing – to develop a prototype system in tourism and agriculture.

Technology for Information and Communication			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
4100-IT-1	a) Indian Institute of Science(IIScBangalore) b)DA-IICT Ahmedabad	Prof.Amara Amara	On advanced device modelling, on new memory and analogue architectures for low consumption systems based on Double-gate technologies.
2900 IT and 4000 IT	Dr Anurag Kumar Indian Institute of Science, Bangalore	Prof. Eitan Altman, INRIA	The extensive exploration of game theory and related topics in the context of technologies such as cellular networks, and mobile ad hoc networks.
3000-IT-1	Dr J.V. Yakhmi Bhabha Atomic Research Centre, Mumbai-	Dr D. Vuillaume (Research Director at CNRS, Head of "Molecular Nanostructures and Devices" group at IEMN-CNRS, BP69, Avenue Poincaré F-59652 cedex, Villeneuve d'Ascq, France	Attempts were made to fabricate low cost quantum devices from molecular monolayers by evaluating the transport behaviour of the barrier/well/barrier, i.e. $\sigma/\pi/\sigma$ structures in order to obtain good molecular RTDs. Electrografting of the octyltrichlorosilane (OTS) monolayer was done on hydrogenated Si (111) surfaces. Highly oriented polyaniline films were deposited using amino-silane SAM as a template.
1308-4	Dr J.V. Yakhmi (BARC) and Prof. S. Ramasesha (IISc, Bangalore)	Prof. O. Kahn (ICMCB, CNRS, Bordeaux)	The concept of a Molecular Magnetic Sponge, or the demonstration of a photomagnetic switching effect, or the fabrication of an octa-cyanomolybdate ferromagnet was obtained.

Water			
Project Code	Indian Collaborator	French Collaborator	Achievements and Outcomes
a) 2600-W1. b)3000-W1 c)4500-WB (on going project)	Indian Institute of Science (IISc), Bangalore	'Institut de Recherche pour le Développement' (IRD), France	(a) The acid production potential of the mined copper and gold tailings was mitigated by the buffering action of lime added for pH control in the flotation process. The microbial ecology of the tailing dump was identified with respect to autotrophic, heterotrophic bacteria and yeasts. b) Facilitated to gain a deeper insight on the tri-dimensional structure of the regolith and on the fluxes of water and major and trace elements. c) Developed an integrated model for analysing the impact of climate change on groundwater irrigated agriculture in the Kabini River basin, Southern India.
2600 W1	Prof. K.A. Natarajan Indian Institute of Science Bangalore	Dr Jean-Jacques BRAUN from IRD, France	Use of sulfate reducing bacteria in bioremediation was established.
IPCPAR 3900-W1	School of Environmental Sciences, Jawaharlal Nehru University (JNU, India)	l'Institut de Recherche pour le Développement (IRD-LTHE-LGGE, France)	Reached the standards of GLACIOCLIM (the Glaciers, an Observatory of the Climate; i.e., mass balance, energy balance and hydrological balance monitoring.
2205-2	Dr M. Subrahmanyam, Indian Institute of Chemical Technology , Hyderabad	Dr P. Boule (retired) Laboratoire de Photochimie Moléculaire et Macromoléculaire Université Blaise Pascal / CNRS Clermont-Ferrand	Through various experiments in the field of 'Photocatalytic methods for destruction of toxic water pollutants', it was concluded that the photocatalysis on TiO ₂ immobilized on solid supports exposed to sunlight may be useful for the decontamination of waste waters since most of bio-resistant pollutants are eliminated. Its needs only sunlight energy, but the concentration and volume treated may be limited, because of ageing and fouling of the catalyst during long term used.

Annexure IV:

List of Industrial Projects and Achievements

Project Code	Title	Achievements	Indian Partner	French Partner	Industrial Partner
IFC/7104-	Insulator : Evaluation and Improvement of the Durability in a Composite Indicator	Considerable progress had been made on silicon derivatives that could be used by SEDIVER. Some of the formulations involving hydrotalcite as a fire retardant, had shown promising results for extending the life of the polymer sleeve and the industry was keen to take this work forward. One patent for formulations of insulation was granted.	Dr R P Singh, Polymer Chemistry Division, NCL, Pune	Prof. Jacques Lacoste LPMM, UMR 6505, CNRS- Universite Blaise Pascal	SEDIVER, Saint-Yorre, France
7110-PET	Characterization and Modelling of the nonlinear creep response of stretched PET	Modelling software	IIT Kanpur , Dr SumitBasu / Dr Kamal K. Kar		Danone Research, Global Packing Platform ,Dr.Serge Batkam

Project Code	Title	Achievements	Indian Partner	French Partner	Industrial Partner
7101	DLC: Diamond like coating		Dr G. S. Bhuvaneshwar Head, Biomedical Technology Wing Sree Chitra Tirunal Institute for Medical Sciences and Technology Poojapura Thiruvananthapuram	Dr R. Suryanarayanan Laboratoire de Physico-Chimie État Solide Bat 414, Université Paris-Sud 91405 Orsay CEDEX FRANCE	Innovations Couches Minces Company
7108	Solar Energy: Technology Transfer of a deposition process to solar energy conversion industries		Dr Partha Chaudhuri Energy Research Unit, Indian Association for the Cultivation of Science 2A and B, Raja S C Mallick Road Jadavpur Kolkata	Dr Christophe Longeaud Laboratoire de Génie Electrique de Paris (UMR 8507, CNRS)	Monsieur Jacques Méot SOLEMS S.A. 3 rue Léon Blum Zone d'Activité Les Glaises 92124 Palaiseau cedex France Prof. Rocca I Cabarrocas Laboratoire de Physique des Interfaces et Couches Minces Ecole Polytechnique 91128 Palaiseau cedex France

Project Code	Title	Achievements	Indian Partner	French Partner	Industrial Partner
7109	Optimisation of an Anaerobic Fixed bed Reactor		Dr Babu Kasilingam Faculty Kumaraguru College of Technology, Coimbatore Dr Joseph Thanickal Kumaraguru College of Technology, Coimbatore	Dr Michel Torrijos Equipe de transfert de Technologie INRA, UR 50, Laboratoire de Biotechnologie de l' Environnement	NASKEO Environnement
7000-Enzymes 7103	Purification and Stabilization Technologies			Dr M. A. Vijayalakshmi Molecular Interactions and Separations Technology Lab	Bangalore Genei Pvt Ltd Bangalore
7106 Ionic Liquids	Development of Ionic Liquids Towards Clean Process For Fine Chemicals"	The industry had successfully formulated misoprostol on 1 kg level and its stability is maintained for three months. A GMP plant established at AVRA labs is producing misoprostol. -----	CSIR- IICT, Hyderabad	Ecole Nationale Supérieure De Chimie de Rennes	Dr A V Rama Rao AVRA Laboratories Pvt. Ltd Hyderabad
7102	Improvements/ Developments in catalyst for phenol dehydration		Dr B. W. Shende Schenectady Herdillia Limited Opp. Junagar Railway Station Navi Mumbai-400 706	Dr Francois Figueras Institut de Recherches sur la Catalyse, CNRS 2, Avenue Albert Einstein 69626 Villeurbanne cedex France	Mr Jean Pierre Joulin Directeur CEramiques Techniques et Industrielles S.A. Usine de Salindres La Resclause Route de St Privat, B.P. 34 30340 SALINDRES France

Project Code	Title	Achievements	Indian Partner	French Partner	Industrial Partner
7102-2	Value addition to (-)-2 amino-1-butanol		Prof. S. Chandrasekharan Department of Organic Chemistry Indian Institute of Science Bangalore 560 012	Prof. Danièle Bonnet-Delpon BIOCIS – CNRS Molécules Fluorées UMR 8076, CNRS Faculté de Pharmacie de Châtenay- Malabry, Université Paris- Sud Tour D3, 5ème Etage Rue J. B. Clément 92296 Châtenay- Malabry France	Dr J. Venkat Raman Chairman and Managing Director Cadila Pharmaceuticals Ltd. Cadila Corporate Campus Sarkhej-Dholka Road, Bhat Ahmedabad-382 210
7105	An eco-friendly process for paracetamol		Dr M. Lakshmi Kantam Head, Inorganic Chemistry and Physical Chemistry Divisions Indian Institute of Chemical Technology Uppal Road Hyderabad 500 007	Dr François Figueras Institut de Recherches sur la Catalyse, CNRS 2, Avenue Albert Einstein 69626 Villeurbanne cedex France	Mr Jayesh Assar, AFNFRAI Manager (Project), Vinati Organics Limited, Shiv Ashish, 2nd Floor Andheri-Kurla Road Mumbai-400 072

Annexure V:

Highly Cited Papers Emerging from CEFIPRA Scientific Collaboration*

Highly Cited Papers	Subject	Project	TC
Nagarajan, R; Mazumdar, C; Hossain, Z; Dhar, SK; Gopalakrishnan, KV; Gupta, LC; Godart, C; Padalia, BD; Vijayaraghavan, R, 'Bulk Superconductivity at an Elevated-Temperature (T(C)Approximate-To-12-K) In A Nickel-Containing Alloy System Y-Ni-B-C', Physical Review Letters, Vol. 72, Iss. 2, Pg.274-277, 1994	MS	Investigations of magnetic mixed valence, and superconducting properties of transition metal-intermetallic compounds and oxides of rare earths (509-1)	581
Chaouat, G; Meliani, AA; Martal, J; Raghupathy, R; Elliot, J; Mosmann, T; Wegmann, TG, 'IL-10 Prevents Naturally-Occurring Fetal Loss In The Cba X Dbal/2 Mating Combination, And Local Defect In IL-10 Production In This Abortion-Prone Combination Is Corrected By In-Vivo Injection Of Ifn-Tau', Journal Of Immunology, Vol. 154, Iss. 9, Pg.4261-4268, 1995	LHS	Immuno regulation at the maternal-fetal interface and its applications (204-1)	303
Mellier, Y, 'Probing the Universe with weak lensing', Annual Review Of Astronomy And Astrophysics, Vol. 37, Iss. , Pg.127-189, 1999	PHY	Gravitational lensing by clusters of galaxies: A tool for physical cosmology (1410-2)	283
Sharma, A; Khanna, R, 'Pattern formation in unstable thin liquid films', Physical Review Letters, Vol. 81, Iss. 16, Pg.3463-3466, 1998	PHY	Equilibrium dynamics and morphology of thin films (1607-1)	223
Chakrabarti, P; Janin, J, 'Dissecting protein-protein recognition sites', Proteins-Structure Function And Genetics, Vol. 47, Iss. 3, Pg.334-343, 2002	LHS	Analysis of protein-protein association in crystals and complexes (2203-2)	219
Mustilli, AC; Merlot, S; Vavasseur, A; Fenzi, F; Giraudat, J, 'Arabidopsis OST1 protein kinase mediates the regulation of stomatal aperture by abscisic acid and acts upstream of reactive oxygen species production', Plant Cell, Vol. 14, Iss. 12, Pg.3089-3099, 2002	LHS	Signal transduction in stomatal guard cells (2203-1)	196
Satishkumar, BC; Govindaraj, A; Vogl, EM; Basumallick, L; Rao, CNR, 'Oxide nanotubes prepared using carbon nanotubes as templates', Journal Of Materials Research, Vol. 12, Iss. 3, Pg.604-606, 1997	MS	Investigations of oxidic and metallic nanomaterials (1308-1)	189

* Source: NISCAIR's bibliometric study of papers emerging from CEFIPRA funded projects 1991-2009

Highly Cited Papers	Subject	Project	TC
Sen, R; Satishkumar, BC; Govindaraj, A; Harikumar, KR; Raina, G; Zhang, JP; Cheetham, AK; Rao, CNR, 'B-C-N, C-N and B-N nanotubes produced by the pyrolysis of precursor molecules over Co catalysts', Chemical Physics Letters, Vol. 287, Iss. 40304, Pg.671-676, 1998	MS	Investigations of oxidic and metallic nanomaterials (1308-1)	189
Bahadur, RP; Chakrabarti, P; Rodier, F; Janin, J, 'A dissection of specific and non-specific protein - Protein interfaces', Journal Of Molecular Biology, Vol. 336, Iss. 4, Pg.943-955, 2004	LHS	Analysis of protein-protein association in crystals and complexes (2203-2)	175
Rao, KK; Gravelle, M; Valente, JS; Figueras, F, 'Activation of Mg-Al hydrotalcite catalysts for aldol condensation reactions', Journal Of Catalysis, Vol. 173, Iss. 1, Pg.115-121, 1998	CHEM	Catalysis of organic reactions using heterogenous modified clay catalysis (1106-2)	171
Srianand, R; Chand, H; Petitjean, P; Aracil, B, 'Limits on the time variation of the electromagnetic fine-structure constant in the low energy limit from absorption lines in the spectra of distant quasars', Physical Review Letters, Vol. 92, Iss. 12, Pg. -, 2004	PHY	Probing the remote universe with QSO absorption lines (3004-3)	167
Satishkumar, BC; Govindaraj, A; Sen, R; Rao, CNR, 'Single-walled nanotubes by the pyrolysis of acetylene-organometallic mixtures', CHEMICAL PHYSICS LETTERS, Vol. 293, Iss. 40180, Pg.47-52, 1998	MS	Investigations of oxidic and metallic nanomaterials (1308-1)	149
Appelo, CAJ; Van der Weiden, MJJ; Tournassat, C; Charlet, L, 'Surface complexation of ferrous iron and carbonate on ferrihydrite and the mobilization of arsenic', Environmental Science and Technology, Vol. 36, Iss. 14, Pg.3096-3103, 2002	Water	Geochemistry of Ganga sediment and groundwater arsenic immobilization. (2200-W1)	145

Note: Life and Health Sciences (LHS); Pure and Applied Chemistry (CHEM); Computers and Information Sciences (CIS); Biotechnology (Biotech); Environmental Sciences (ES); Earth and Planetary Sciences (EPS); Pure and Applied Physics (PHY); Material Sciences (MS); Technology for Information and Communication (TIC); Instrumentation (Inst.);TC implies Total Citations

Annexure VI:

Processes Created from Completed Research Projects

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
704-2	1996	1	LHS	Evolution of active indolo (3,2-c) quinolines	Euk. DNA topoisomerase-I Inhibitors as anti-tumoral agents
				1-cyclization reactions	Transformations of simple starting materials into monocyclic, bicyclic, and polycyclic scaffolds that can be further elaborated into specific targets.
208-1	1996	2	MS	Thin Film Characterization	
				1-Mirage Spectroscopy	Kinetic studies on experimental conditions representing of flotation process
				2-Microscopic-infra red radiometry	Effect on the thermal radiation characteristics of the opposing seal surface are measured
806-1	1996	1	MS	Hydroformylation of olefins	
				1-Gas-Liquid-liquid Catalytic Reaction	Industrial applications of homogeneous catalysis by precious metal complexes are limited due to the difficult recovery or regeneration of such catalysts.
814-1	1996	2	PHY	Microelectronic Materials	
				1-Photothermal microscopy	Measure optical absorption and thermal characteristics of a sample
				2- Photoacoustic microscopy	High ultrasonic resolution and strong optical contrast in a single modality
1008-1	1997	8	MS	Number/weight-average molecular weight	

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
				1-Gel permeation chromatography (GPC)	separates analytes on the basis of size
				2-Vapor pressure osmometry (VPO)	measure average molecular weight of polymer
				Transition Temperature	
				1-Differential scanning calorimetry	A thermo analytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature
				Structure of Different Phases	
				1-Cross polarised optical microscopy	For qualitative analysis involves the use of cross-polarized light
				2-optical microscopy	Use visible light so that samples may be directly observed by eye.
				3-x-ray diffraction	Diffraction is the scattering of a coherent wave by the atoms in a crystal. A diffraction pattern results from interference of the scattered waves.
				Thin film	
				1-UV visible microscopy	It uses light in the visible and adjacent (near-UV and near-infrared (NIR)) ranges. The absorption or reflectance in the visible range directly affects the perceived color of the chemicals involved
				Side chain liquid crystalline polymers	
				1-Nonlinear Optical (NLO) chromophores	A chromophore is the part of a molecule responsible for its color.
1007-1	1997	2	CHEM	Transition from vesicle to micelle	
				1-CTAHNC-System	cetyltrimethylammoniumhydroxy naphthalenecar-boxylate (CTAHNC) as function of temperature. Use for micelle formation

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
				2-SANS experiment	Small-angle neutron scattering (SANS)
					Polymer characterization (molten polystyrene)
1114-1	1998	1	PHY	Nonlinear Integrated Optical Devices	
				1-Parametric Fluorescence	Light emitted by a parametric amplifier without signal or input.
					An optical parametric amplifier emits some light even if there is no signal and idler input. This phenomenon is called parametric fluorescence.
1208-3	1998	1	MS	Star Shaped Polymethacrylates	
				1-Anionic and Group transfer polymerization (GTP)	Controlled/living radical polymerization methods
2501-1	2004	1	Maths	Algebraic Groups in Arithmetic and geometry	
				1-Motivic Cohomology	Standard Conjectures On Algebraic Cycles, in algebraic geometry
2403-3	2004	2	LHS	Brain Activities	
				1-Electroencephalography (EEG)	Measures voltage fluctuations resulting from ionic current flows within the neurons of the brain.
				2-Magnetic Resonance Imaging (MRI)	Visualize internal structures of the body in detail.
2404-1	2004	2	PHY	Electron System	
				1-d-wave superconductivity	Wave function of an atomic orbital cooled below a characteristic critical temperature.
				2-frustrated spin system	Antiferromagnetic triangular lattice studied.
1911-2	2004	2	EPS	Aerosol and Indian Monsoons	
				1-Global Climate Model (GCM)	Weather Forecasting, understanding the climate, and projecting climate change.
				2-Total Ozone Mapping spectrometer (TOMS)	Satellite instrument for measuring ozone values

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
1403-2	1999	1	LHS	Nystatin Resistance in <i>Ascobulus immersus</i>	
				1-MIP(Methylation Induced Premeiotically) Phenomenon	Gene silencing (RNA is unable to make a protein during translation) by DNA methylation and is always reversible as discovered in <i>Ascobulus immersus</i>
1806-2	2001	1	CHEM	Ruthenium Catalysis	
				1-Bisoxazoline Catalysts	Used extensively in asymmetric catalysis (Enantioselective synthesis/chiral synthesis)
1603-1	2001	1	LHS	<i>Drosophila</i> :Genetic Screen	
				1-Homeotic gene trans-regulation	Fly gene (Alh) has the exact genetic footprint of Human genes AF10/AF17 (leukemia)
1803-1	2001	1	LHS	GM(Genetic Modified) Egg Plant	
				1-gfp.gus gene Transformation by <i>Agrobacterium tumefaciens</i>	<i>A. tumefaciens</i> infects the plant through its Ti plasmid. The Ti plasmid integrates T-DNA into the chromosomal DNA of its host plant cells.
3903-1	2012	1	LHS	3D comparison of proteins	
				1-Superimpose protein structures	Analysis of protein – protein interactions with a structural alphabet.
3805-1	2012	1	CHEM	Transformation of Underivatized Carbohydrates	
				1-Studies and Liquid crystalline behaviour of glycolamphiphilic Compound	Glycolamphiphilic Compound: Micelle formation and drug release behaviours
3808-1	2012	2	MS	Recovery in Metallic Materials	
				1-High Angular resolution EBSD (electron backscatter diffraction)	Technique that provides rapid local orientation measurements of most crystalline materials

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
				2-Multiple glancing X-ray micro-diffraction	Used to record the diffraction pattern of thin films with minimum contribution from substrate.
P101-1	1989	1	EPS	Ocean Atmosphere System	
				1- Atmospheric and oceanic GCMs (AGCM and OGCM)	Weather Forecasting, sea ice and land-surface components.
506-1	1995	4		Zeolite-supported metal catalysis	
				1-IR-spectroscopy	Deals with the infrared region of the electromagnetic spectrum, used to identify and study chemicals.
				3-CO-Probe (Carbon Monoxide Probe)	Electrochemical sensors (fast responding) are an intelligent microprocessor.
				4- X-ray photoelectron spectroscopy (XPS)	Measures the elemental composition, empirical formula, chemical state and electronic state of the elements that exist within a material.
704-1	1995	3	LHS	Indian mice genetic model in immunology	
				1-T-cell selection	T-cell receptor (TCR) on the cell surface and mature in Thymus.
				2- Clonal deletion	Mechanism of tolerance for immature thymocytes; For mature T cells, tolerance is considered to reflect energy rather than deletion, and to be a consequence of defective presentation of antigen.
				3-TCR V β 17 Gene Polymorphism	Classified on the basis of size of the Restriction
					Fragment Length Polymorphism (RFLP)

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
603-1	1995	4	Env.	Frankia N2 –fixing microsymbiont	
				1-Phylogeny of genus Frankia	Nucleotide sequence of the 16s gene.
				2-PCR/RFLP method target nif-gene	Polymerase chain reaction (PCR)
					Restriction fragment length polymorphism,(RFLP)
					Nif(nitrogen fixation) gene.
				3-DNA extraction, amplification, clone and sequence by direct soil.	
				4-Germination of spores by Alginate	Calcium Alginate is used in artificial seed formation in plant tissue culture.
1403-1	1999	3	LHS	Pre-cancerous and cancerous oral lesion	
				1-Chimeric tumor suppressor	Use in gene therapy (use of DNA as a pharmaceutical agent to treat disease)
				2-Oral cancer cell line and primary culture	
				3-P53ELISA (Enzyme-linked immunosorbent assay)	Detection of circulatory P53- antibody
1106-2	1999	1	CHEM	Catalysis of Organic Reaction	
				1-Acylation of crow ether bearing aryl ring	Acetic anhydride using sulphated zirconia (an efficient solid acid catalyst for esterification of myristic acid with short chain alcohols)
1403-2	1999	1	LHS	Nystatin Resistance in Ascobolus immersus	
				1-MIP(Methylation Induced Premeiotically) Phenomenon	Gene silencing (RNA is unable to make a protein during translation) by DNA methylation and is always reversible discovered in Ascobolus immersus

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
1806-2	2001	1	CHEM	Ruthenium Catalysis	
				1-Bisoxazoline Catalysts	Used extensively in asymmetric catalysis (Enantioselective synthesis/chiral synthesis)
1603-1	2001	1	LHS	Drosophila :Genetic Screen	
				1-Homeotic gene trans-regulation	Fly gene (Alh) exact genetic footprint of Human genes AF10/ AF17 (leukemia)
1803-1	2001	1	LHS	GM(Genetic Modified) Egg Plant	
				1-gfp.gus gene Transformation by Agrobacterium tumefaciens	A. tumefaciens infects the plant through its Ti plasmid. The Ti plasmid integrates T-DNA, into the chromosomal DNA of its host plant cells.
3903-1	2012	1	LHS	3D comparison of proteins	
				1-Superimpose protein structures	Analysis of protein – protein interactions with a structural alphabet.
3805-1	2012	1	CHEM	Transformation of Underivatized Carbohydrates	
				1-Studies and Liquid crystalline behaviour of glycolamphiphilic Compound	Glycolamphiphilic Compound: Micelle formation and drug release behaviours
3808-1	2012	2	MS	Recovery in Metallic Materials	
				1-High Angular resolution EBSD (electron backscatter diffraction)	Technique that provides rapid local orientation measurements of most crystalline materials
				2-Multiple glancing X-ray micro-diffraction	Used to record the diffraction pattern of thin films, with minimum contribution from substrate.

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
3103-1	2009	1	LHS	Viruses Pathogenic to <i>Microbacterium rosenbergii</i>	
				1-Nested polymerase chain reaction	Reduce non-specific binding in products due to the amplification of unexpected primer binding sites
3403-4	2009	3	LHS	Saponins from <i>Chlorophytum</i> species	Saponins (triterpin or steroid glycosides)
				1-Nuclear magnetic resonance (NMR)	Observation of specific quantum mechanical magnetic properties of the atomic nucleus.
				2-Mass Spectrometry (LC-MS/ HPLC)	Detection and potential identification of chemicals in the presence of other chemicals
				3-Bioassays of steroid saponins	Evaluating the toxicity of saponins.
3408-4	2009	2	MS	Crystal Growth and Studies	
				1-Neutron diffraction	Depth measurements of the full strain tensor to be made in thick components
				2-Synchrotron X-rays	Rapid measurements of strains inside components
3508-1	2009	1	MS	Material used for energy storage	
				1-Transition metal phosphate	An organic solvent-based sol-gel method has been utilized for the synthesis of transition metal phosphates. More than one metal were synthesized in solution at low temperature.
3000-B1	2009	2	Biotech	YAM improvement by DNA marker	
				1-Genetic Diversity By DNA Finger Printing (AFLP/SSRs or Microsatellites)	Amplified fragment length polymorphism, a highly sensitive tool used in molecular biology to detect DNA polymorphisms
				2-Comparative analysis by Microsatellite markers	Microsatellites/ Simple Sequence Repeats / short tandem repeats (STRs), are repeating sequences of 2-6 base pairs of DNA.

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
2/5/2013					
2103-2	2003	1	LHS	BT (<i>Bacillus thuringiensis</i>) Toxins for Transgenic Coffee	
				1- Pest resistant transgenic coffee strain development	By BT gene transformation system
2203-1	2003	2	LHS	Signal transduction in stomatal guard cell	
				1-Infrared thermography (IRT) / thermal imaging/ thermal video	Stomatal movement detect radiation in the infrared range of the electromagnetic spectrum (9–14 μm) and produce images of that radiation, called thermograms.
				2-ROS(reactive oxygen species) production	Caused by ABA (Absciscic Acid) MJ (Methyl Jasmonate) during stomata closing.
2305-1	2003	2	CHEM	Bioactive Molecule libraries	
				1- Loading of carboxylic acid on to PEG (polyethyleneglycol)	Covalent modification of biological macromolecules
				2-Flurination of Heterocycles	Combination of a carbon-centered nucleophile with an electrophilic source of fluorine to afford organofluorine compounds.
3504-3	2009	2	PHY	ESA'S Satellite "PLANCK"	
				1-Angular Power Spectrum	A 2-dimensional angular power spectrum measures the power of a particular angular scale.
				2-Cosmic microwave background (CMB)	Observing the microwave sky shows that the temperature of the CMB is not exactly the same in all directions, it is anisotropic.
3504-4	2009	2	PHY	Dielectric Nonlinear Media	
				1-Modulation instability (MI) spectra in optical fibers	MI has been analyzed extensively in multispan optical amplified systems.
				2- Self Induced Transparency (SIT) solitary waves	In a one-dimensional periodic structure doped uniformly with resonance two-level atoms.

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
3705-2	2011	2	CHEM	Carbon Nanotubes	
				1-Atomic Force Microscopy (AFM)	High-resolution type of scanning probe microscopy, with demonstrated resolution on the order of fractions of a nanometer.
				2-Short Linear Polymer Chain Studies by Electrophoresis	Separation molecules on the Charged interface between the particle surface. and the surrounding fluid.
2909-1	2008	2	Env.	1.Prepared the SOC (Soil Organic Carbon) stock maps for loss estimation in SOC and comparison of behavior of specific tracts of land having a particular status to adjacent lands of different status 2.advanced methods of data mining, multi-agent system modelling for landscape units, and intensive use of GIS	SOC (Soil Organic Carbon)-Soils contain carbon (C) in both organic and inorganic forms. In most soils (with the exception of calcareous soils) the majority of C is held as soil organic carbon (SOC). The term soil organic matter (SOM) is used to describe the organic constituents in the soil (tissues from dead plants and animals, decomposed products and the soil microbial biomass). The term 'soil organic carbon' refers to the C occurring in the soil in SOM.
1804-1	2001	2	LHS	1.Developed a protein-DNA energy analysis 2.Developed a multi-copy DNA sequence scanning algorithm (ADAPT)	
1615-1	2001	1	CHEM	Development of a comprehensive 2-D model for a totally solute/protein rejecting membrane to explain fouling and predict critical flux	Fouling of the membrane- Membrane fouling is a process where solute or particles deposit onto a membrane surface or into membrane pores in a way that degrades the membrane's performance.
1802-1	2002	2	CIS	1.Improved design of the radix-4 arithmetic processor 2.For chip design, developed new	

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
				techniques with efficient mapping technology onto FPGA (Field-programmable gate arrays), algorithms for floor-plan partitioning	
2104-1	2002	1	PHY	1. Developed a new type of material- polymorphous silicon and developed solar devices incorporating this material based on new PECVD processes	PECVD- Plasma-enhanced Chemical vapour deposition (PECVD) is a process used to deposit thin films from a gas state (vapor) to a solid state on a substrate.
1814-1	2002	1 process 1 design	PHY	1. Design of optimized DCFs(Dispersion-compensating fibres) suitable for single as well as multi channel signal transmission 2. Design of erbium-doped DCFs (ED-DCF)	Dispersion compensating fibre -The dispersion-compensating fibre according to the present invention, is an optical fibre having a structure which, when constituting an optical transmission line together with a dispersion-shifted fiber, whose zero-dispersion wavelength is in a 1.5- μm wavelength band, for guiding light signals in the 1.5- μm wavelength band or 1.6- μm wavelength band, is capable of improving transmission characteristics of the whole optical transmission line and allowing the dispersion to be compensated efficiently and the size thereof to become smaller; and has a structure for improving the total dispersion slope of the optical transmission line while in a fully compensating state for the dispersion of the dispersion-shifted fiber.
2003-2	2002	1	LHS	Constructed cDNA library from pine roots,standardised protocol for RNA isolation, identified and characterised four Pinus pinaster auxin up-regulated genes	

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
2104-2	2002	2	PHY	1. Overlap fermions with better chiral properties used for non-trivial behaviour of pion screening length in the QGP (Quark Gluon Plasma) 2. new method of analysis of anisotropic flow in nucleus-nucleus collision proposed	QGP- Quark-gluon plasma (QGP) or quark soup is a (possible) phase of quantum chromodynamics (QCD), which exists at extremely high temperature and/or density. This phase consists of asymptotically free quarks and gluons, which are the basic building blocks of matter.
1908-1	2002	1	MS	1. CVD (Chemical vapour deposition) of diamond films by Heteroepitaxial Process	Heteroepitaxial- Epitaxy refers to the deposition of an overlayer on a crystalline substrate, where the overlayer is in registry with the substrate. The overlayer is called an epitaxial film or epitaxial layer. The term epitaxy comes from the Greek roots epi, meaning "above", and taxis, meaning "in ordered manner". Heteroepitaxy is a kind of epitaxy performed with materials that are different from each other. In heteroepitaxy, a crystalline film grows on a crystalline substrate or film of a different material.
2204-1	2003	1	PHY	Systematic generation of all the data combinations by using commutative algebra and realising the connection of the problems of laser frequency noise cancellation with commutative algebra	
2305-2	2003	1	CHEM	Electrostatics complexation of surface-modified gold nanoparticles and polyelectrolytes at the air-water interface	

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
2013-1	2003	2	Water	1. Developed an appropriate model of the unsaturated/partially saturated zones in the weathered rock overlying the fractured zone 2. Derived calibration of the catchment model from the precipitation and piezometric data	Catchment model- Catchment modelling refers to modelling spatially distributed hydrological processes over the entire catchment. It is distinct from lumped-conceptual modelling, which does not deal with spatial distribution of parameters. Any catchment model can be used for rainfall-runoff modelling.
3805-1	2012	1	CHEM	Development of HPLC (High Performance Liquid Chromatography) analytical method for Synthesis of new amphiphilic liquid crystalline compounds	Amphiphilic compounds- Amphiphile (from the Greek , amphis: both and philia: love, friendship) is a term describing a chemical compound possessing both hydrophilic (water-loving, polar) and lipophilic (fat-loving) properties. Such a compound is called amphiphilic or amphipathic. e.g- Hydrocarbon based surfactants
3903-1	2012	1	LHS	Superimposition of protein 3D structures using a structural alphabet (proteins blocks)	Structural alphabet-Three-dimensional protein structures can be described with a library of 3D fragments that define a structural alphabet. Such an alphabet, composed of 16 patterns of five consecutive amino acids, called Protein Blocks (PBs)
3808-2	2011		MS	Controlled chemical and biochemical synthesis of anisotropic magnetic nanostructures and functional nanocomposites	
3907-1	2011	3	EPS	Development of the SINTEX-F2 model and statistical tools 2. DEMETER coupled models for role of ISOs (Intra-Seasonal Oscillations) 3. Analysis	ISOs- The intraseasonal oscillations are a naturally occurring component of our coupled ocean-atmosphere system. They significantly affect the atmospheric circulation

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
				for role of ENSO (El Nino-Southern Oscillation) in the modulation of ISOs	throughout the global Tropics and subtropics, and also strongly affect the wintertime jet stream and atmospheric circulation features over the North Pacific and western North America.
3709-1	2011	1	Env.	Genomic analysis of metal transportomes from 4 divergent <i>Pseudomonas</i> (bacteria) species	
3708-2	2011	process 1, design 3	MS	1.Design of composite gels of polystyrene and OPVs (oligo p-phenylenevinylene) 2.Design of composite gels of OPVs (oligo p-phenylenevinylene) and carbon nanotubes (CNTs) 3. Design of various organogel morphology	Organogel-A hydrogel with an organic liquid, not water, as the dispersion means. It can be regarded as a semi-solid preparation which has an immobilized external apolar phase
3608-1	2011	1	MS	Computational model developed through Basic constitutive model for glassy amorphous polymers and Cohesive zone model for crazing	Crazing-Crazing is a phenomenon that frequently precedes fracture in some glassy thermoplastic polymers. Crazing occurs in regions of high hydrostatic tension, or in regions of very localized yielding, which leads to the formation of interpenetrating microvoids and small fibrils. If an applied tensile load is sufficient, these bridges elongate and break, causing the microvoids to grow and coalesce; as microvoids coalesce, cracks begin to form.

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
3704-1	2011	3	PHY	1. Maps of vector magnetic field from synthetic spectro-polarimetric data sets for a given sunspot 2. Developed Tomographic method to analyse a filament eruption	
				3. Solar active events to study relation between geo-effective magnetic cloud (MC)	
3800-W1	2010	1	Water	Developed Catalyst PdSn/Al ₂ O ₃ and PdSn/TiO ₂ and nano-electrocatalysts PdSn/Ti and PdAg/Ti and two routes the catalytic and electrocatalytic compared	
3404-4	2010	2	PHY	1. Developed Mathematical model for describing appearance of spontaneous oscillation in uterine tissue 2. Control algorithm for terminating spatiotemporal chaotic activity in excitable media using a spatially extended method	
3308-2	2010	1	MS	Preparation of crack free Nanoporous Ceramic Membranes over Clay-Alumina Support	
2702-1	2005	2	CIS	1. Development of an Indian Postal Data Base and pre-processing algorithm 2. Development of Bilingual numeral recognition system	
2700-b1	2005	1	Biotech	1. A novel plate screen to investigate HGT1 Mutants was set up	

Project ID	Year	No. of Process	Project Area	Process Found	Explanation
2805-1	2006	2	CHEM	1. A novel technology proposed for the treatment of Pre Hydrolysis Liquor (PHL) 2. A three parameter simulation model developed to predict permeate aflux and rejection	
2900-IT-1	2006	2	TIC	1.A new approach for optimal association of stations and access point in a WLAN was developed 2.Mathemetical approach to obtain data transfer and WEB browsing in LAN was developed	
2705-1	2005	4	CHEM	1. Design and construction of a offline post channel reactor at microscale level 2. Development of a new programme for chip surface treatment 3.Development of a new strategy for low cost chip 4. Development of multi technique platform for microfluidic chip characterization	
3108-2	2007	1	MS	An insulating commercial polymer was prepared by industrially acceptable methods	
2903-1	2005	1	LHS	A novel target of JNK signaling was used for analysis of RRab30	

Note: Life and Health Sciences (LHS); Pure and Applied Chemistry (CHEM); Pure and Applied Mathematics (Maths); Computers and Information Sciences (CIS); Biotechnology (Biotech); Environmental Sciences (Env.); Earth and Planetary Sciences (EPS); Pure and Applied Physics (PHY); Material Sciences (MS); Technology for Information and Communication (TIC)

Annexure VII:

Products Emerging from Completed Research Projects

Project Code	Year	Product No.	Product Area	Product	Further explanation
404-1	1995	1	LHS	Human Monoclonal antibodies reactive with rabies virus	Monoclonal antibodies- Monoclonal antibodies (mAb or moAb) are monospecific antibodies that are the same because they are made by identical immune cells that are all clones of a unique parent cell, in contrast to polyclonal antibodies which are made from several different immune cells. Monoclonal antibodies have monovalent affinity, which bind to the same epitope.
1403-1	1999	3	LHS	1. Inducible chimeric tumour suppressor 2. In vitro and in vivo (xenografts in nude mice) model of tobacco related oral cancer 3. p53-ELISA for detection of circulating p53-antibodies	p53 is a tumour suppressor that is regulated by transcriptional, post-transcriptional, and post-translational mechanisms in response to stress. Studies demonstrate that p53 is critical for the prevention of tumorigenesis and may potentially be involved in at least half of all known cancers. p53 functions as a transcription factor to regulate genes involved in apoptosis, cell cycle, senescence, metabolism, angiogenesis, immunity, differentiation, and migration. Moreover, p53 is phosphorylated at multiple sites, including Ser15, following DNA damage.

Project Code	Year	Product No.	Product Area	Product	Further explanation
1501-1	1999	2	Maths	Arithmetic study of Automorphic forms and its application to Arithmetic 1. (Theta correspondence, Tate cycles on a product of Hilbert modular surfaces, Local Langlands correspondence for quaternion algebras, sign in the functional equation of Rankin product L-function, torsion of CM elliptic curves, self-dual representations of finite groups of Lie-type, module structure of the ring of integers of a number field 2. Construction of a CTWS (controlled Taylor-Wiles system) for $GSp(4)$	Automorphic forms- In mathematics, the general notion of automorphic form is the extension to analytic functions, perhaps of several complex variables of the theory of modular forms. It is in terms of a Lie group G , to generalize the groups $SL(2, \mathbb{R})$ or $PSL(2, \mathbb{R})$ of modular forms, and a discrete group to generalise the modular group, or one of its congruence subgroups.
2008-1	2002	2	MS	1. Modified window glass system for use as the substrate of thermochromic coatings 2. ECD device fabrication with tungstic acid-hydrogen peroxide based WO_3 coatings	
1908-1	2002	1	MS	Highly textured diamond sheets of large area ($>1 \text{ sqcm}$)	
2008-2	2004	3	MS	Three different microstructures Er, Hm and TNS3 of multiphase Titanium Aluminides	
2603-2	2005	1	LHS	Two-component tissue adhesive from biocompatible and biodegradable polysaccharides	Polysaccharides are long carbohydrate molecules of monosaccharide units joined together by glycosidic bonds. They range in structure from linear to

Project Code	Year	Product No.	Product Area	Product	Further explanation
					highly branched. Polysaccharides have a general formula of $C_x(H_2O)_y$ where x is usually a large number between 200 and 2500. Considering that the repeating units in the polymer backbone are often six-carbon monosaccharides, the general formula can also be represented as $(C_6H_{10}O_5)_n$ where $40 \leq n \leq 3000$
2705-1	2006	2	CHEM	1. Micro post column reactors 2. new polymer for microfluidic chip surface treatment	Microfluidic chips- These can be as simple as a flat piece of glass or plastic with microscopic flow channels or they can be more complex devices that include electronics, optics, and micro pumps. Microfluidic chips all have one thing in common; they move fluids from one place to another by means of the micro channels. Some have optics incorporated in them in order to study fluids in the chip and this is common in medical applications. Some microfluidic chips are used in mechanical applications where cleaning fluids or other liquids need to get “plumbing” to get them from one place to another. Microfluidic chips are feats of miniscule plumbing where more than a hundred cell cultures or other experiments can take place in a rubbery silicone integrated circuit of the size of a quarter. These chips range from simple designs for single sample injection to complex designs with multiple functional areas that allow for multiple samples/diluent addition, microfluidic mixing,

Project Code	Year	Product No.	Product Area	Product	Further explanation
					and microfluidic separation. The medical community is always looking for cheaper and faster ways to analyze all kinds of fluids and microfluidic chips are helping meet this need.
3108-2	2007	1	MS	Polyaniline film with poly (vinyl chloride): An insulating commercial polymer	Polyaniline (PANI) is a conducting polymer of the semi-flexible rod polymer family. Polyaniline and the other conducting polymers such as polythiophene, polypyrrole, and PEDOT/PSS have potential for applications due to their light weight, conductivity, mechanical flexibility, and low cost. Polyaniline is especially attractive because it is relatively inexpensive, has three distinct oxidation states with different colours and has an acid/base doping response. This latter property makes polyaniline an attractive agent for acid/base chemical vapour sensors.
3405-3	2009	1	CHEM	A novel high temprature reactor (high enthalpy source) using experimental and CFD (Computational fluid dynamics)simulation techniques	Computational fluid dynamics, usually abbreviated as CFD, is a branch of fluid mechanics that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows.
3800-W1	2010	1	Water	1.25A (1.5L/hr) capacity electrochemical nitrate removal unit	
3804-1	2011	2	PHY	1.Fabrication of a low temperature insert 2.Fabrication of graphene based NEMS devices	NEMS devices- Nanoelectromechanical systems are devices integrating electrical and mechanical functionality on the nanoscale. NEMS form the logical next miniaturization step from so-called microelectromechanical

Project Code	Year	Product No.	Product Area	Product	Further explanation
					systems, or MEMS devices. NEMS typically integrate transistor-like nanoelectronics with mechanical actuators, pumps, or motors, and may thereby form physical, biological, and chemical sensors.

Note: Life and Health Sciences (LHS); Pure and Applied Chemistry (CHEM); Pure and Applied Mathematics (Maths); Computers and Information Sciences (CIS); Biotechnology (Biotech); Environmental Sciences (Env.); Earth and Planetary Sciences (EPS); Pure and Applied Physics (PHY); Material Sciences (MS); Technology for Information and Communication (TIC); Instrumentation (Inst.)

Annexure VIII:

Designs Emerging from Completed Research Projects

Project No.	Year	No. of Designs	Thrust Area	Description
905-1	1997-1998	1	LHS	Design of new photosensitizers based on porphyrin and phthalocyanine core.
1111-1	1998-1999	1	PHY	A petrological model for the closepet batholith has been established.
2705-1	2005-2006	1	LHS	Design and construction of a offline post channel reactor at microscale.
2702-1	2005-2006	1	CIS	Adaptation of the existing latin word recognition system to bangla city names recognition.
3708-2	2011	3	MS	1. Design of composite gels of polystyrene and oligo (p-phenylenevinylene) (OPV) with improved physical properties 2.Design of composite gels of OPVs and Carbon nanotubes(CNTs) 3.Design of various organogel morphology by toying with end groups and solvent type.
2209-1	2004	1	Env.	Multiple reactors have been designed.
1806-2	2001	1	CHEM	Design, synthesis and characterization of a few ruthenium(II) bisoxazoline catalyst.
2904-3	2008	1	CHEM	Stable beams from the BATRC-TIFR pelletron to study the effect of nuclear structure.
3800-B1	2011-2012	1	Biotech	Successful design and synthesis of promoters for ethanol production.
3905-1	2011-2012	2	LHS	1.A number of new monochromic SAA have been designed and synthesized. 2.Several families of imino sugar analogues have been synthesized using classical strategy or Multi Component Reactions(MCR).

Project No.	Year	No. of Designs	Thrust Area	Description
3505-1	2008-2009	1	LHS	Design and synthesis of nanoscopic structures built from (hyper) polarisable dipolar chromophores.
2006-1	2002-2003	1	CHEM	Comprehensive computational model were developed to capture trailing vortices behind impeller blades.
1814-1	2002-2003	4	PHY	1.Design and fabrication of a DCF(Dispersion Compensated optical; Fibres) 2.Design of a set of broadband DCF'swith low sensitivity to low detrimental 3.Novel design of a concatenated set of DCF'shaving different D's to achieve a broadband DCF device. 4. Design of an inherently gain flattened erbium doped fibre amplifier.

Note: Life and Health Sciences (LHS); Pure and Applied Chemistry (CHEM); Pure and Applied Mathematics (Maths); Computers and Information Sciences (CIS); Biotechnology (Biotech); Environmental Sciences (Env.); Earth and Planetary Sciences (EPS); Pure and Applied Physics (PHY); Material Sciences (MS); Technology for Information and Communication (TIC); Instrumentation (Inst.)

Annexure IX:

List of Projects

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
A computer based search for the principles of protein-DNA recognition (1804-1)	9	33.679	3.742	264	183	29.33
A formal model for task execution in a real time distributed computing systems (302-1)	6	1.967	0.328	15	2	2.50
A study of some factorization and decomposition problems of graphs (401-1)	3	0.775	0.258	15	9	5.00
A study of transport and self diffusivity within zeolites (3408-2)	1	3.471	3.471	0	0	0.00
AB initio calculations of atomic and molecular processes occurring in stars and in the interstellar medium (110-1)	10	17.915	1.792	185	74	18.50
Accretionary processes of juvenile crust and continental growth: the late Archaean eastern Dharwar craton (2307-1)	1	2.697	2.697	9	3	9.00
Advanced materials: Superconductors and semiconductors by laser Raman spectroscopy (308-1)	11	9.742	0.886	67	34	6.09
Advanced numerical methods in nonlinear fluids mechanics and acoustics (3401-1)	4	8.55	2.138	5	5	1.25
Algebraic groups in arithmetic and geometry (2501-1)	3	2.666	0.889	24	24	8.00
Analysis of GPLs biosynthesis in <i>Mycobacteria</i> (3403-3)	2	5.056	2.528	6	6	3.00
Analysis of protein-protein association in crystals and complexes (2203-2)	2	9.638	4.819	351	288	175.50
Archaean lithosphere in south India (1111-1)	7	12.612	1.802	336	135	48.00
Asymptotic analysis in partial differential equations (1001-1)	5	3.257	0.651	61	16	12.20

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Atomistic studies of supported metal oxide nanosystems (3808-2)	2	8.8	4.400	0	0	0.00
Automata and concurrency: Suntactic methods for verifications (2102-1)	3	0.515	0.172	36	34	12.00
Automata, infinite words and codes (1602-1)	4	2.031	0.508	4	2	1.00
Basulo virus resistance in transgenic silkworms (2603-3)	1	1.06	1.060	4	4	4.00
Biodiversity and function of bacteria from Antarctica pack ice and sea water. (2409-1)	2	5.336	2.668	38	37	19.00
Biomimetic synthesis and evaluation of B-amino alcohols (3005-1)	7	18.522	2.646	77	77	11.00
Bioremediation of trace cobalt from simulated spent decontaminating solutions of nuclear power reactors using <i>E-coli</i> expressing NiCoT genes. (3709-1)	2	6.509	3.255	0	0	0.00
Brane-world phenomenology (2904-2)	1	6.503	6.503	2	2	2.00
<i>Candida albicans</i> membrane composition and liposomal amphotericin B antifungal activity: Physico-chemical studies (304-1)	3	4.759	1.586	48	15	16.00
Catalysis of organic reactions using heterogenous modified clay catalysis (1106-2)	7	17.086	2.441	309	144	44.14
Catalytic antibodies against factor VIII structure, function and implication for therapy. (2800-B1)	2	12.583	6.292	44	44	22.00
Catalytic antibodies in immune-mediated disorders (4103-2)	2	6.138	3.069	0	0	0.00
Catalytic reaction engineering using ionic liquids (3305-2)	1	1.758	1.758	0	0	0.00
Chaos, turbulence and collective relaxation in non-equilibrium plasmas (1301-1)	1	1.994	1.994	18	7	18.00
Characterization of LmSIR2 and search for target specific inhibitors (3603-1)	5	9.341	1.868	20	20	4.00
Characterization of membrane proteins from, <i>M. Tuberculosis</i> (2303-2)	1	0	0.000	15	13	15.00
Chemistry and physics of molecular-based materials (1308-4)	5	8.18	1.636	134	76	26.80
Chemistry and spectroscopy of PAH and their clusters (3405-3)	1	1.81	1.810	0	0	0.00

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Clusters and cluster assembled materials (1508-4)	1	0.725	0.725	20	11	20.00
Collider physics (1701-1)	5	19.697	3.939	190	118	38.00
Conservation laws and Hamilton jacobi equations (3401-2)	1	1.225	1.225	0	0	0.00
Control of systems of partial differential equations (3701-1)	3	2.932	0.977	0	0	0.00
CORCoP: Compilation and optimization for reconfigurable co-processors (1802-1)	2	0	0.000	1	0	0.50
Crystal growth and studies of new magnetic compounds (3408-4)	1	7.328	7.328	0	0	0.00
Cytokines and integrins in successful implantation and parturition (1604-1)	5	12.261	2.452	240	178	48.00
Deactivation due to coking and regeneration of zeolite catalysis (506-2)	19	39.68	2.088	300	170	15.79
Deciphering history of the Indo-Eurasia collision from detailed plate tectonics of the Indian ocean (3307-1)	1	4.062	4.062	0	0	0.00
Deformation behaviour of lamellar intermetallic alloys (2308-2)	7	7.547	1.078	49	38	7.00
Design and development of zeolites-supported metal catalysis in the synthesis of chemicals and chemical intermediates (506-1)	8	13.479	1.685	99	49	12.38
Design, mechanistic studies and biological activity of some new sensitizers for the photodynamic therapy (PDT) of tumorous cells and leukemias (905-1)	8	15.294	1.912	212	108	26.50
Design, parallel synthesis, and evaluation of glucosamine-6-p synthase targeted inhibitors (3003-1)	5	12.924	2.585	24	24	4.80
Design, synthesis, and biological evaluation of cationized PNAs as antisense agents ex-vivo and in-vivo (3205-1)	2	4.062	2.031	17	17	8.50
Development of functionalized carbon nanotubes (3705-2)	2	28.666	14.333	3	3	1.50
Development of high critical current high Tc superconducting thin films for fabrication of SQUIDS and infrared detectors (808-2)	5	8.772	1.754	16	11	3.20

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Development of ionic ferromagnetic fluids (1508-2)	5	8.099	1.620	66	31	13.20
Development of photocatalysis for destruction of toxic water pollutants by advanced oxidation process (2205-2)	11	24.995	2.272	260	197	23.64
Development of polycrystalline silicon thin films for application in photo-voltaic devices (1414-1)	3	3.39	1.130	14	10	4.67
Development of reliable transformation system for improvement of coffee (2603-1)	1	0.951	0.951	3	3	3.00
Dilute magnetic semiconductors: Bulk and Nano (3604-1)	3	6.797	2.266	0	0	0.00
Direct force measurements between colloidal particles (2007-1)	4	10.088	2.522	44	31	11.00
DNA transcription in an artificial nucleus (2303-1)	2	6.393	3.197	21	21	10.50
Dynamics of lopsided spiral galaxies (2704-1)	6	26.705	4.451	199	199	33.17
Dynamics of microscopic and reactive processes in liquids (1106-1)	3	9.741	3.247	71	38	23.67
Dynamics of solar and stellar interiors: Seismology and activity (2504-3)	6	24.44	4.073	38	38	6.33
Ecological and evolutionary genetics of Indian drosophila (1103-1)	21	38.003	1.810	473	221	22.52
Effluent treatment through membrane processes (2805-1)	11	20.392	1.854	72	72	6.55
Electrical characterization and reliability of organic self-assembled monolayers for applications in advanced deep submicron devices (1614-1)	2	6.191	3.096	107	42	53.50
Electrodeposition and investigation of low cost polycrystalline thin films of II-VI semiconductors for solar energy conversion (1108-2)	5	7.782	1.556	122	38	24.40
Electronic structure and transport properties in Nanostructures (3104-2)	17	54.962	3.233	112	112	6.59
Electrostatically controlled interaction of colloidal nanoparticles and polyelectrolytes at the air-water interface (2305-2)	11	31.887	2.899	252	225	22.91

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Emerging strategies for wireless communication networks (4000-IT-1)	1	0	0.000	0	0	0.00
Equilibrium dynamics and morphology of thin films (1607-1)	23	58.44	2.541	1034	579	44.96
Eukaryotic DNA topoisomerase I inhibitors as antitumoral agents: Synthesis and biological evaluation of analogues of an active Indoloquinoline (704-2)	1	2.257	2.257	17	11	17.00
Evaluation and validation of systems of assimilation (2707-1)	1	2.491	2.491	0	0	0.00
Evaluation of the effects of post-transcriptional modifications on the biological functions of <i>E.coli</i> tr RNA-SER(GGA) (1203-2)	4	11.593	2.898	29	18	7.25
Exploring self-organized criticality in a granular medium (1508-3)	2	3.274	1.637	5	4	2.50
Fluctuating interfaces and colloidal suspensions (607-1)	15	66.281	4.419	306	125	20.40
Formal specifications and development of real time reactive programmes (502-2)	4	0.052	0.013	0	0	0.00
Formal specifications and verification of hybrid and reactive systems (2202-1)	3	0.783	0.261	4	3	1.33
Fundamental and applied aspects of Portevin-Le-Chatelier effect-Chaos and fracture (1108-1)	5	4.918	0.984	64	34	12.80
Galaxy formation: The AGN-Spheroid Connection (2804-1)	4	9.352	2.338	38	38	9.50
Generation of nanophases particles by energetic ion beams (2808-3)	6	7.826	1.304	41	41	6.83
Genetic engineering of egg plant for disease resistance (1803-1)	1	0.631	0.631	23	13	23.00
Geochemistry of Ganga sediment and groundwater arsenic immobilization. (2200-W1)	1	3.123	3.123	128	77	128.00
Geometry (1601-2)	2	1.035	0.518	12	7	6.00
Geometry and number theory (501-2)	3	1.163	0.388	11	3	3.67
Gravitational lensing by clusters of galaxies: A tool for physical cosmology (1410-2)	8	25.285	3.161	332	233	41.50

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Gravitational wave data analysis for the laser interferometer space antenna (2204-1)	2	8.094	4.047	19	19	9.50
Gravitational waves from neutron star binaries (2904-1)	10	42.971	4.297	274	274	27.40
Handwriting recognition for postal automation (2702-1)	2	0	0.000	0	0	0.00
Homogeneous catalysis of oxidation of organic substrates to value added products using transition metal complexes (2905-1)	8	26.305	3.288	49	49	6.13
Hot and dense matter in quantum chromodynamics (3104-3)	6	20.133	3.356	164	164	27.33
Hox-and Ecdysone targets in heart and muscle remodelling (3203-1)	2	8.721	4.361	9	9	4.50
Hydro-Bio-geochemical cycles in two small experimental watersheds of south India. (3000-W1)	2	3.348	1.674	7	7	3.50
Hydrogenation of unsaturated carbonyl compounds and nitriles (306-1)	2	2.996	1.498	110	37	55.00
Identification of <i>Mycobacterium tuberculosis</i> genes (2403-1)	1	3.11	3.110	10	10	10.00
Immunoregulation at the maternal-fetal interface and its applications (204-1)	9	24.995	2.777	574	242	63.78
Indian mice as new genetical models in immunology : Tools for the study of immune tolerance (704-1)	3	5.975	1.992	62	28	20.67
Influence of the surface energetics of the reinforcement on the development of microstructure of the matrix and fiber/matrix interactions in composites (1408-1)	1	1.715	1.715	1	0	1.00
Influences of impurities in correlated electron systems (2208-1)	2	4.106	2.053	11	11	5.50
Infrared astronomy (1910-1)	1	3.781	3.781	5	5	5.00
Injectable adhesive biomaterials for vascular applications (2603-2)	2	5.287	2.644	17	17	8.50
Integrability aspects of discrete and continuous equations (1201-1)	11	12.117	1.102	84	38	7.64

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Interaction of aflatoxin B1 and hepatitis B virus in the pathogenesis of hepatocellular carcinoma: Studies using duck hepatitis B virus animal model (104-1)	3	8.58	2.860	40	25	13.33
Interdroplets interaction and reaction rate modulation of reverse micelle mediated reactions (907-1)	2	1.034	0.517	11	7	5.50
Interfaces in complex fluids (2504-2)	1	2.418	2.418	14	14	14.00
Interfacial tension and wetting phenomena in quasibinary liquids (107-1)	22	47.485	2.158	450	213	20.45
Investigations of magnetic mixed valence, and superconducting properties of transition metal-intermetallic compounds and oxides of rare earths (509-1)	12	31.88	2.657	852	536	71.00
Investigations of oxidic and metallic nanomaterials (1308-1)	11	16.965	1.542	932	411	84.73
Investigations of superconductivity and magnetism in the newly discovered quaternary rare earth transition metal borocarbides (1808-1)	8	14.999	1.875	55	44	6.88
Ion beam and laser processing of advanced ceramics and related synthesis of thin films (308-2)	7	12.665	1.809	112	33	16.00
Ion beam induced phase and property modifications in advanced ceramics (1208-1)	9	13.434	1.493	148	53	16.44
Ionospheric perturbations linked to seismic activity (2807-1)	2	2.347	1.174	15	15	7.50
Isolation and characterization of biologically active saponins from chlorophytum species (3403-4)	4	8.363	2.091	2	2	0.50
Laser spectroscopy research in solid state ionics (308-4)	3	2.271	0.757	10	8	3.33
Lattice dynamical and structural study of Be-based II-VI semiconductor alloys (3204-1)	6	17.854	2.976	29	29	4.83
Leishmania infection in new inbred mouse strains (3303-4)	2	31.646	15.823	5	5	2.50
Mapping of the brassica genomes (1203-1)	5	8.15	1.630	112	47	22.40

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Mathematical modelling and simulation of the characteristics of laminated smart composite structures (2308-1)	2	0	0.000	0	0	0.00
Mathematical topics in hyperbolic systems of conservations laws (2601-2)	5	1.478	0.296	21	15	4.20
Memory effects in Three-Level systems (3904-1)	2	4.662	2.331	0	0	0.00
Modelling of zeolite framework relaxation (2605-2)	6	16.2	2.700	99	97	16.50
Modelling vibrational spectra of complex molecular systems with molecular dynamics technique (3305-1)	1	3.047	3.047	6	6	6.00
Modelling and controller synthesis for mechanical systems with fluids and flexible elements (3602-1)	1	0	0.000	3	3	3.00
Modelling and design of automated manufacturing systems (1002-1)	1	0	0.000	0	0	0.00
Modelling of nonlinear effects in high power optical cavities of laser interferometric gravitational wave detectors (1010-1)	1	1.421	1.421	15	10	15.00
Molecular analysis of the functional role of palmitoylation of human erythrocyte membrane protein 4.2 (1903-1)	3	18.132	6.044	101	81	33.67
Molecular biology of the silk work: Use of genetic engineering for biotechnology applications (103-1)	6	26.868	4.478	69	26	11.50
Molecular characterization of levan sucrase gene of <i>Zymomonas mobilis</i> (203-1)	5	8.732	1.746	110	53	22.00
Molecular scale electronics using self assembly; Electronique moleculaire auto-assemblee (3000-IT-1)	6	9.369	1.562	115	115	19.17
Multi scale interactions and predictability of the Indian summer monsoon (3907-1)	1	3.082	3.082	0	0	0.00
Multi-nuclear solid state structural studies of molecular sieves (2105-1)	7	27.614	3.945	79	57	11.29
Nanostructured organic materials and composites- A bottom up approach (3605-2)	2	6.113	3.057	1	1	0.50
New Strategies for wireless communication networks (2900-IT-1)	23	9.016	0.392	91	91	3.96

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Non-linear hyperbolic equations and applications (501-1)	2	0.61	0.305	10	2	5.00
Nonlinear hyperbolic and elliptical equations and applications (1601-1)	1	0	0.000	0	0	0.00
Nonlinear partial differential equations and control problems (1901-2)	1	0.334	0.334	0	0	0.00
Non-natural peptides in asymmetric catalysis: Metal –mediated synthesis of peptide-based materials and their applications (3805-2)	1	3.762	3.762	0	0	0.00
Novel hydrophobically modified polymers: synthesis, characterisation and rheology (2508-1)	1	2.111	2.111	2	2	2.00
Novel in-situ second phase whisker formation reactions in ceramic matrices and repairation of ceramic matrixceramic whisker reinforced composites from such powders (408-1)	3	2.757	0.919	10	6	3.33
Novel layered and framework metal oxides, synthesis and investigation of structure, properties and reactivity (1308-3)	15	28.845	1.923	182	81	12.13
Novel magnetic ground states of low-dimensional systems (3508-2)	2	10.5	5.250	2	2	1.00
Novel synthetic methodologies in combinatorial chemistry for the preparation of bio-active molecule libraries (2305-1)	3	8.429	2.810	115	82	38.33
Occurrence of mutations in non-dividing cells of <i>escherichia coli</i> (2703-1)	4	18.325	4.581	76	76	19.00
Optical soliton propagation in various dielectric nonlinear media (3504-4)	14	31.195	2.228	38	38	2.71
Optimal decelopment and management of ground water in weathered fractured aquafiers. (2013-W1)	4	2.099	0.525	20	18	5.00
Orientation dependent recovery in metallic materials (3808-1)	4	7.348	1.837	2	2	0.50
Osmoregulation in Azopirillum: Molecular basis and Metabolic Engineering (2003-1)	4	8.346	2.087	17	15	4.25

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Osmotic regulation of proU transcription and interaction of nucleoid protein H-NS with DNA in <i>Escherichia coli</i> : in Vitro studies (1303-1)	1	5.239	5.239	10	7	10.00
Oxygen isotopic anomaly from ozone to other trace molecules (3207-1)	4	13.97	3.493	28	28	7.00
Palaeomagnetism of great DYKE and vindhyan super group rocks of India (3607-1)	1	3.172	3.172	4	4	4.00
Partial order models and logics for concurrency (502-1)	1	0	0.000	5	5	5.00
Pharmacogenetics of Busulfan and cyclophosphamide (2403-2)	1	9.782	9.782	38	38	38.00
Photomagnetic investigations on magnetic oxides (3708-1)	2	8.162	4.081	1	1	0.50
Physical and Mathematical modelling of LISA mission (3504-1)	1	3.035	3.035	2	2	2.00
Plasmonic properties of checkerboard metallic structures and films (3804-2)	1	1.384	1.384	0	0	0.00
Polyarylene sulphides : Synthesis, characterization, and processing (1108-3)	5	7.597	1.519	31	19	6.20
Polymer materials with multiscale porosity (2808-2)	9	21.283	2.365	52	52	5.78
Precision tests of chiral perturbation theory (2504-1)	6	28.753	4.792	88	77	14.67
Preparation and characterization of thin films of perovskites for the electrocatalysis of oxygen (408-3)	8	10.696	1.337	179	78	22.38
Probing the remote universe with QSO absorption lines (3004-3)	11	49.216	4.474	452	452	41.09
Processes and products' research on the production, design and developments of new materials by chimie douce (308-3)	6	10.325	1.721	163	74	27.17
Production of pharmaceuticals through genetic transformation (2503-2)	4	7.084	1.771	26	26	6.50
Prognostic values of cytokines in cervical cancer (2004-1)	3	5.988	1.996	41	27	13.67
Proion protein properties in salt and Nucleic acid solutions (2803-1)	3	10.749	3.583	41	41	13.67
Protein transport in <i>Plasmodium falciparum</i> erythrocytes (2503-1)	2	12.314	6.157	35	35	17.50

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Proton magnetic resonance technique in weathered-fractured aquifers. (2700-W1)	1	1.288	1.288	1	1	1.00
Quark gluon plasma (2104-2)	5	13.025	2.605	44	39	8.80
RandD in dispersion-compensated optical fibres and amplifiers (1814-1)	3	1.01	0.337	2	2	0.67
Radiation induced electronic phase separation in epitaxial films perovskite manganates (2808-1)	14	40.05	2.861	147	147	10.50
Reaction engineering of gas-liquid-liquid catalytic reactions: Application to hydroformylation (806-1)	1	27.074	27.074	76	42	76.00
Reconstruction of the changes in the oxygen minimum of the Arabian Sea during the late quaternary links with the monsoon. (1809-1)	7	18	2.571	159	86	22.71
Redox mechanisms in high Tc superconductors and search for new copper and non-copper based superconductors (808-1)	3	5.186	1.729	0	0	0.00
Reinforcement of elastomers by fillers (308-5)	7	6.665	0.952	79	26	11.29
Research and development in nonlinear integrated optical devices (1114-1)	7	10.442	1.492	30	21	4.29
Rheology of dense granular flows (3404-1)	9	37.819	4.202	32	32	3.56
Rigorous results in quantum information theory, potential scattering, and supersymmetric quantum mechanics (3404-3)	2	2.102	1.051	2	2	1.00
Rigorous results on schrodinger equations and foundations of quantum theory and applications to particle physics and astrophysics (1501-2)	7	7.213	1.030	33	26	4.71
RNA Editing as a molecular tool to generate cytoplasmic male sterile lines in rice (2003-4)	1	10.896	10.896	105	68	105.00
Role of glutathione transporters in stress tolerance (2700-B1)	3	14.108	4.703	53	53	17.67
Scaling and multiscaling in MHD turbulence (2404-2)	11	33.711	3.065	85	74	7.73

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Scientific design of flotation separation reagents based on molecular recognition at mineral surfaces (1315-1)	1	2.813	2.813	24	15	24.00
Searching link between pairing dependent silencing and co-suppression (2903-2)	1	4.289	4.289	20	20	20.00
Segregation and surface properties of Pd-base alloys: Experimental and theoretical approach (806-2)	7	9.244	1.321	174	61	24.86
Segregation and surface properties of Pt-based alloys: Experimental and theoretical approach (106-1)	3	4.403	1.468	65	26	21.67
Selective acylation and alkylation of reactions of aromatics using solid acid catalysts (1906-1)	22	33.341	1.516	173	128	7.86
Selective oxidation of organic compounds over vanadium silicate molecular sieves (1006-1)	9	20.799	2.311	204	83	22.67
Self-organized nanostructures at surfaces (3608-2)	6	15.001	2.500	3	3	0.50
Semi-analytic modelling of structure formation (1710-1)	6	45.441	7.574	187	120	31.17
Sensitivity of monsoonal climate to modelling of clouds and land surface processes (711-1)	1	3.105	3.105	7	3	7.00
Sensitivity of the Indian summer monsoon to anthropogenic climate change (2407-1)	1	1.243	1.243	21	17	21.00
Side chain liquid crystalline polymers for nonlinear optical applications: Synthesis, characterization and measurements (1008-1)	7	9.755	1.394	94	77	13.43
Signal transduction in stomatal guard cells (2203-1)	7	41.405	5.915	461	311	65.86
Silicon-germanium thin films for solar cells' applications (3104-1)	2	3.62	1.810	3	3	1.50
Solid-state supramolecular chemistry applied to the designing of non-linear optical materials (1708-1)	3	4.634	1.545	26	17	8.67
Specifications and verification of distributed systems: The finite state and higher-order cases (1502-1)	8	1.455	0.182	57	32	7.13

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Spin transition in Fe(II) and Cyano bridged molecular magnets (3408-3)	3	10.435	3.478	8	8	2.67
Stable solar cells based on new PECVD processes (2104-1)	10	16.032	1.603	74	59	7.40
Statics and dynamics of low-dimensional disordered systems (3404-2)	20	61.972	3.099	65	65	3.25
Stellar populations and galactic evolution: A photometric and astrometric sample survey (510-1)	7	13.704	1.958	170	90	24.29
Stereoselective chemical synthesis of herbicidins, a novel family of natural products with valuable herbicidal activity (1305-1)	1	0.236	0.236	17	6	17.00
Structural and functional diversity of PcG complexes (3303-1)	6	38.671	6.445	28	28	4.67
Structural and fundamental studies on Enhancing factor gene (803-1)	2	0.87	0.435	3	3	1.50
Structure and rheological properties of worm like micelles (1007-1)	7	19.923	2.846	192	84	27.43
Structure-function relationship of viral proteins and their use in obtaining transgenic plants resistant to viral infection (603-2)	9	12.068	1.341	86	57	9.56
Studies on geometry of banach spaces (2601-1)	3	1.455	0.485	4	4	1.33
Studies of strongly correlated electron systems (2404-1)	13	54.845	4.219	336	326	25.85
Studies on ecology, molecular biology and genetics of <i>frankia</i> , an actionorrhizal nitrogen fixing microsymbiont (603-1)	7	14.345	2.049	245	117	35.00
Studies on plant tRNAs and tRNA genes (303-1)	3	1.852	0.617	10	9	3.33
Studies on the halogen intercalated carbons (508-1)	5	6.846	1.369	67	22	13.40
Studies on the regulation of p53 mRNA translation (3703-1)	3	15.342	5.114	8	8	2.67
Study of breast cancer in high risk ethnic groups (404-2)	8	9.521	1.190	84	41	10.50
Study of epithelia morphogenesis development (2903-1)	1	6.543	6.543	6	6	6.00

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Study of genetic alterations in pre-cancerous and cancerous oral lesions (1403-1)	4	10.039	2.510	146	91	36.50
Study of higher dimensional grammars and picture languages (102-1)	2	0.616	0.308	14	2	7.00
Study of hydrogels of cationic bile salts (2605-1)	4	15.741	3.935	43	42	10.75
Study of magnetic thin films for recording appliances (108-1)	7	9.84	1.406	58	31	8.29
Study of the transmission of proteins through porous membrane and the fouling of the membrane (1615-1)	1	1.965	1.965	5	4	5.00
Study of viscous fingering in lifting heleshaw cell (2304-1)	2	2.637	1.319	18	10	9.00
Study of factors prevailing for the selection of mycorrhizal strains in ash pond (2109-1)	3	3.252	1.084	8	8	2.67
Study on virus (MrNV/XSV and WSSV) pathogenic to <i>Macrobrachium rosebergii</i> in India (3103-1)	8	14.665	1.833	27	27	3.38
Supramolecular interactions in multichromophores (3505-1)	2	8.275	4.138	2	2	1.00
Surface and thin film characterization by mirage spectroscopy (208-1)	13	7.663	0.589	92	50	7.08
Surfactant effects on atomic ordering in semiconductor epilayers (2604-1)	2	6.26	3.130	3	3	1.50
Susy, Higgs and CP at colliders and in astrophysics (3004-2)	16	58.95	3.684	95	95	5.94
Symbolic clustering of french spot satellite data for forest inventory (912-1)	4	0.827	0.207	3	3	0.75
Synthesis and structural studies of N-glycoprotein analogues. (3200-B1)	2	9.476	4.738	20	20	10.00
Synthesis and applications of mesoporous materials (3705-1)	2	7.116	3.558	3	3	1.50
Synthesis and biological studies of Azido and Aminohexopyranosyl Nucleosides (3405-1)	4	9.924	2.481	15	15	3.75
Synthesis of novel chiral heterogenous symmetric oxidation catalysis (3105-2)	1	2.707	2.707	8	8	8.00
Systematic Effects in CMB of ESA's Satellite "Planck" (3504-3)	1	4.179	4.179	0	0	0.00

Projects	Papers	Sum-IF	Avg. IF	TC	6 TC	Avg. TC/ Paper
Targeted delivery of RNAi using synthetic vectors for gene therapy of head and neck squamous cell carcinomas (3700-B1)	2	8.73	4.365	0	0	0.00
The mechanics of living matter (3504-2)	23	134.824	5.862	118	118	5.13
The new ceramic oxide high temperature super conductors and their properties (408-2)	3	9.774	3.258	25	8	8.33
The regulation of nutrient uptake by rab GTPases in two pathogenic human parasites, <i>Leishmania</i> and <i>Plasmodia</i> (3303-3)	1	9.38	9.380	1	1	1.00
Theoretical modelling of catalytic properties of zeolites (1206-1)	4	7.225	1.806	53	30	13.25
Theoretical study of electronic and structural properties of clusters using ab initio molecular dynamics (1901-1)	12	42.893	3.574	185	109	15.42
Theory of molecular intercalation into DNA (3105-1)	3	9.426	3.142	35	35	11.67
Thermal and photochemical degradation and stabilization of polymer blends and alloys (308-6)	5	3.827	0.765	32	13	6.40
Three phase catalytic reactors: Comparison of upflow and downflow operations (1806-1)	1	1.547	1.547	10	6	10.00
Total synthesis of new sugar mimics from cyclic polyenes (3605-1)	2	7.788	3.894	0	0	0.00
Transcriptome, MDR transcription regulators and micro arrays of human pathogen <i>Candida</i> (3403-2)	3	10.691	3.564	25	25	8.33
Transregulation of homeotic genes in drosophila-targeted genetic screens and molecular characterization (1603-1)	3	13.038	4.346	69	46	23.00
Ultrafast processes in low-dimensional semiconductors (1514-1)	4	16.446	4.112	45	33	11.25
Use of Laser Heterodyne system with AOS for atmospheric studies at tropical latitude (811-1)	1	0.95	0.950	1	1	1.00
Water and liquid effluent treatment: Role of cavitation (2209-1)	3	4.867	1.622	88	46	29.33
Wave propagation in disordered excitable media and simulated cardiac tissue (3404-4)	3	9.147	3.049	10	10	3.33

Annexure X:

List of Journals and Conference Proceedings in which Papers are Published from CEFIPRA Projects with Impact Factor of 2009

2004 INTERNATIONAL CONFERENCE ON SIGNAL PROCESSING and COMMUNICATIONS (SPCOM)
2006 IEEE 63RD VEHICULAR TECHNOLOGY CONFERENCE, VOLS 1-6, ISSN:1090-3038
2006 4TH INTERNATIONAL SYMPOSIUM ON MODELING AND OPTIMIZATION IN MOBILE, AD HOC AND WIRELESS NETWORKS, VOLS 1 AND 2
2007 5TH INTERNATIONAL SYMPOSIUM ON MODELLING AND OPTIMIZATION IN MOBILE, AD HOC AND WIRELESS NETWORKS AND WORKSHOPS, VOLS 1-2
2007 IEEE INTERNATIONAL SYMPOSIUM ON A WORLD OF WIRELESS, MOBILE AND MULTIMEDIA NETWORKS, VOL 1
25TH IEEE INTERNATIONAL CONFERENCE ON COMPUTER COMMUNICATIONS, VOLS 1-7, PROCEEDINGS IEEE INFOCOM 2006, ISSN:0743-166X
ACTA CRYSTALLOGRAPHICA SECTION C-CRYSTAL STRUCTURE COMMUNICATIONS, ISSN:0108-2701.782
ACTA MECHANICA, ISSN:0001-5970, IF: 1.137
ACTA PHYSICA POLONICA B, ISSN:0587-4254, IF: 0.648
ADVANCED INFORMATION PROCESSING TECHNIQUES FOR LAN AND MAN MANAGEMENT, ISSN:8755-8920
ADVANCES IN COMPUTING SCIENCE-ASIAN' 98, ISSN:0302-9743
AICHE JOURNAL, ISSN:0001-1541, IF: 1.955
AMERICAN JOURNAL OF MATHEMATICS, ISSN:2712689, IF: 1.337
AMERICAN JOURNAL OF REPRODUCTIVE IMMUNOLOGY, ISSN:8755-8920, IF: 2.172
ANALYTICA CHIMICA ACTA, ISSN:281298, IF: 3.757
ANALYTICAL BIOCHEMISTRY, ISSN:0003-2697, IF: 3.287
ANNALES DE L INSTITUT FOURIER, ISSN:0373-0956, IF: 0.904
ANNALES GEOPHYSICAE, ISSN:0992-7689, IF: 1.648
ANNALS OF PURE and APPLIED LOGIC, ISSN:0168-0072, IF: 0.667
ANNUAL REVIEW OF ASTRONOMY AND ASTROPHYSICS, ISSN:0066-4146, IF: 25.64
ANNUAL REVIEW OF BIOPHYSICS AND BIOMOLECULAR STRUCTURE, ISSN:1056-8700, IF: 18.955
ANNUAL REVIEW OF FLUID MECHANICS, ISSN:0066-4189, IF: 9.353
ANTEC '96: PLASTICS - RACING INTO THE FUTURE, VOLS I-III - VOL I: PROCESSING; VOL II: MATERIALS; VOL III: SPACIAL AREAS ,
ANZIS 96 - 1996 AUSTRALIAN NEW ZEALAND CONFERENCE ON INTELLIGENT INFORMATION SYSTEMS, PROCEEDINGS
APPLIED CATALYSIS A-GENERAL, ISSN:0926-860X, IF: 3.564
APPLIED CATALYSIS B-ENVIRONMENTAL, ISSN:0926-3373, IF: 5.252
APPLIED CLAY SCIENCE, ISSN:0169-1317, IF: 2.784

APPLIED MATHEMATICS AND OPTIMIZATION, ISSN:0095-4616, IF: 0.757
APPLIED MICROBIOLOGY AND BIOTECHNOLOGY, ISSN:0175-7598, IF: 2.896
APPLIED PHYSICS LETTERS, ISSN:0003-6951, IF: 3.554
APPLIED SURFACE SCIENCE, ISSN:0169-4332, IF: 1.616
AQUACULTURE, ISSN:0044-8486, IF: 1.925
ARCHIVES OF MICROBIOLOGY, ISSN:0302-8933, IF: 1.927
ARCHIVES OF PHYSIOLOGY AND BIOCHEMISTRY, ISSN:1381-3455
ARCHIVES OF VIROLOGY, ISSN:0304-8608, IF: 1.909
ARKIVOC, ISSN:1551-7004, IF: 1.09
ASTRONOMY and ASTROPHYSICS, ISSN:0004-6361, IF: 4.179
ASTRONOMY and ASTROPHYSICS SUPPLEMENT SERIES, ISSN:0365-0138
ASTRONOMY AND ASTROPHYSICS, ISSN:0004-6361, IF: 4.179
ASTROPHYSICAL JOURNAL, ISSN:0004-637X, IF: 7.364
ASTROPHYSICS AND SPACE SCIENCE, ISSN:0004-640X, IF: 1.404
AT THE EDGE OF THE UNIVERSE: LATEST RESULTS FROM THE DEEPEST ASTRONOMICAL SURVEYS
ATMOSPHERIC CHEMISTRY AND PHYSICS, ISSN:1680-7316, IF: 4.881
ATMOSPHERIC ENVIRONMENT, ISSN:1352-2310, IF: 3.139
ATOMIC DATA AND NUCLEAR DATA TABLES, ISSN:0092-640X, IF: 1.413
AUTOMATA, LANGUAGES, AND PROGRAMMING, ISSN:0302-9743
BERICHTE DER BUNSEN-GESELLSCHAFT-PHYSICAL CHEMISTRY CHEMICAL PHYSICS, ISSN:0005-9021
BIOCHEMICAL GENETICS, ISSN:375623, IF: 0.878
BIOCHEMICAL JOURNAL, ISSN:0264-6021, IF: 5.155
BIOCHEMISTRY, ISSN:0006-2960, IF: 3.226
BIOCHEMISTRY AND MOLECULAR BIOLOGY INTERNATIONAL, ISSN:1039-9712
BIOCHIMICA ET BIOPHYSICA ACTA, ISSN:0006-3002, IF: 11.685
BIOESSAYS, ISSN:0265-9247, IF: 5.125
BIOLOGICAL JOURNAL OF THE LINNEAN SOCIETY, ISSN:0024-4066, IF: 2.04
BIOLOGY OF REPRODUCTION, ISSN:534503, IF: 3.3
BIOMACROMOLECULES, ISSN:1525-7797, IF: 4.502
BIOMATERIALS, ISSN:0142-9612, IF: 7.365
BIOORGANIC and MEDICINAL CHEMISTRY LETTERS, ISSN:0960-894X, IF: 2.65
BIOPHYSICAL JOURNAL, ISSN:0006-3495, IF: 4.39
BIOPOLYMERS, ISSN:593672, IF: 2.605
BIOTECHNOLOGY AND BIOENGINEERING, ISSN:0006-3592, IF: 3.377
BIOTECHNOLOGY LETTERS, ISSN:0141-5492, IF: 1.636
BLOOD, ISSN:0006-4971, IF: 10.555
BRITISH JOURNAL OF CANCER, ISSN:0007-0920, IF: 4.346
BULLETIN OF MATERIALS SCIENCE, ISSN:0250-4707, IF: 0.783
CARBOHYDRATE RESEARCH, ISSN:0008-6215, IF: 2.025

CARBON, ISSN:0008-6223, IF: 4.504
CATALYSIS COMMUNICATIONS, ISSN:1566-7367, IF: 3.000
CATALYSIS LETTERS, ISSN:1011-372X, IF: 2.021
CATALYSIS TODAY, ISSN:0920-5861, IF: 3.526
CATENA, ISSN:0341-8162, IF: 1.933
CELL, ISSN:0092-8674, IF: 31.152
CELL CYCLE, ISSN:1538-4101, IF: 4.087
CELLULAR IMMUNOLOGY, ISSN:2501760, IF: 2.698
CHAOS SOLITONS and FRACTALS, ISSN:0960-0779, IF: 3.315
CHEMBIOCHEM, ISSN:1439-4227, IF: 3.824
CHEMICAL BIOLOGY and DRUG DESIGN, ISSN:1747-0277, IF: 2.473
CHEMICAL COMMUNICATIONS, ISSN:1359-7345, IF: 5.504
CHEMICAL ENGINEERING and TECHNOLOGY, ISSN:0930-7516, IF: 1.266
CHEMICAL ENGINEERING JOURNAL, ISSN:1385-8947, IF: 2.816
CHEMICAL ENGINEERING SCIENCE, ISSN:0009-2509, IF: 2.136
CHEMICAL GEOLOGY, ISSN:234366, IF: 3.407
CHEMICAL PHYSICS LETTERS, ISSN:0009-2614, IF: 2.291
CHEMICAL SOCIETY REVIEWS, ISSN:0306-0012, IF: 20.086
CHEMISTRY OF MATERIALS, ISSN:0897-4756, IF: 5.368
CHEMISTRY-A EUROPEAN JOURNAL, ISSN:0947-6539, IF: 5.382
CHINESE JOURNAL OF PHYSICS, ISSN:0577-9073, IF: 0.515
CIRCULATION, ISSN:1980590, IF: 14.816
CLASSICAL AND QUANTUM GRAVITY, ISSN:0264-9381, IF: 3.029
CLINICAL AND EXPERIMENTAL IMMUNOLOGY, ISSN:2631452, IF: 3.009
CLINICAL REVIEWS IN ALLERGY and IMMUNOLOGY, ISSN:1080-0549, IF: 2.597
COLLOID AND POLYMER SCIENCE, ISSN:0303-402X, IF: 2.057
COLLOIDS AND SURFACES A-PHYSICO-CHEMICAL AND ENGINEERING ASPECTS, ISSN:0927-7757, IF: 1.988
COLLOIDS AND SURFACES B-BIOINTERFACES, ISSN:0927-7765, IF: 2.6
COMMUNICATIONS ON PURE and APPLIED ANALYSIS, ISSN:1534-0392, IF: 0.918
COMPARATIVE AND FUNCTIONAL GENOMICS, ISSN:1531-6912, IF 0.826
COMPLEX DYNAMICS IN PHYSIOLOGICAL SYSTEMS: FROM HEART TO BRAIN, ISSN:1860-0832
COMPTES RENDUS DE L ACADEMIE DES SCIENCES SERIE II FASCICULE C-CHIMIE, ISSN:1387-1609
COMPTES RENDUS DE L ACADEMIE DES SCIENCES SERIE I-MATHEMATIQUE, ISSN:0764-4442
COMPTES RENDUS GEOSCIENCE, ISSN:1631-0713, IF: 0.931
COMPTES RENDUS MATHEMATIQUE, ISSN:1631-073X, IF: 0.529
COMPTES RENDUS PHYSIQUE, ISSN:1631-0705, IF: 1.384
COMPUTER AIDED VERIFICATION, ISSN:0302-9743
COMPUTER NETWORKS, ISSN:1389-1286, IF: 1.201
COMPUTER NETWORKS, ARCHITECTURE AND APPLICATIONS, ISSN:0926-549X

COMPUTER PHYSICS COMMUNICATIONS, ISSN:0010-4655, IF: 1.958
COMPUTERS and CHEMICAL ENGINEERING, ISSN:0098-1354, IF: 1.808
COMPUTERS and STRUCTURES, ISSN:0045-7949, IF: 1.44
CONCUR'97 : CONCURRENCY THEORY, ISSN:0302-9743
CONCUR'98: CONCURRENCY THEORY, ISSN:0302-9743
CONTRIBUTIONS TO MINERALOGY AND PETROLOGY, ISSN:2227889, IF: 3.497
CONTROL AND CYBERNETICS, ISSN:0324-8569, IF: 0.378
COORDINATION CHEMISTRY REVIEWS, ISSN:0010-8545, IF: 11.225
CURRENT GENETICS, ISSN:0172-8083, IF: 1.84
CURRENT MICROBIOLOGY, ISSN:0343-8651, IF: 1.33
CURRENT OPINION IN SOLID STATE and MATERIALS SCIENCE, ISSN:1359-0286, IF: 4.000
CURRENT SCIENCE, ISSN:0011-3891, IF: 0.782
CZECHOSLOVAK JOURNAL OF PHYSICS, ISSN:0011-4626
DALTON TRANSACTIONS, ISSN:1477-9226, IF: 4.081
DEFECT PROPERTIES AND RELATED PHENOMENA IN INTERMETALLIC ALLOYS, ISSN:0272-9172
DESALINATION, ISSN:0011-9164, IF: 2.034
DEVELOPMENTAL BIOLOGY, ISSN:0012-1606, IF: 4.379
DIFFERENTIAL GEOMETRY AND ITS APPLICATIONS, ISSN:0926-2245, IF: 0.669
DISCRETE MATHEMATICS, ISSN:0012-365X, IF: 0.548
DISEASES OF AQUATIC ORGANISMS, ISSN:0177-5103, IF: 1.687
EARTH AND PLANETARY SCIENCE LETTERS, ISSN:0012-821X, IF: 4.062
ECOLOGICAL ENTOMOLOGY, ISSN:0307-6946, IF: 1.697
EIGHTH INTERNATIONAL CONFERENCE ON DOCUMENT ANALYSIS AND RECOGNITION, VOLS 1 AND 2, PROCEEDINGS
EMBO REPORTS, ISSN:1469-221X, IF: 6.907
EMULSIONS, FOAMS, AND THIN FILMS
ENVIRONMENTAL CHEMISTRY, ISSN:1448-2517, IF: 1.85
ENVIRONMENTAL SCIENCE and TECHNOLOGY, ISSN:0013-936X, IF: 4.63
ENVIRONMENTAL TECHNOLOGY, ISSN:0959-3330, IF: 0.762
EPL, ISSN:0295-5075, IF: 2.893
EUKARYOTIC CELL, ISSN:1535-9778, IF: 3.806
EUROPEAN JOURNAL OF ORGANIC CHEMISTRY, ISSN:1434-193X, IF: 3.096
EUROPEAN JOURNAL OF PHYSICS, ISSN:0143-0807, IF: 0.741
EUROPEAN JOURNAL OF SOLID STATE AND INORGANIC CHEMISTRY, ISSN:0992-4361
EUROPEAN PHYSICAL JOURNAL A, ISSN:1434-6001, IF: 1.968
EUROPEAN PHYSICAL JOURNAL B, ISSN:1434-6028, IF: 1.466
EUROPEAN PHYSICAL JOURNAL C, ISSN:1434-6044, IF: 2.746
EUROPEAN PHYSICAL JOURNAL D, ISSN:1434-6060, IF: 1.42
EUROPEAN PHYSICAL JOURNAL E, ISSN:1292-8941, IF: 2.019
EUROPHYSICS LETTERS, ISSN:0295-5075, IF: 2.893

EVOLUTION, ISSN:0014-3820, IF: 5.429
EVOLUTION and DEVELOPMENT, ISSN:1520-541X, IF: 3.179
EXTREMOPHILES, ISSN:1431-0651, IF: 2.000
FEBS LETTERS, ISSN:0014-5793, IF: 3.541
FEMS MICROBIOLOGY LETTERS, ISSN:0378-1097, IF: 2.199
FIRST INTERNATIONAL CONGRESS ON ADHESION SCIENCE AND TECHNOLOGY - INVITED PAPERS - Festschrift in Honor of Dr. K.L. Mittal on the occasion of his 50th Birthday
FISH and SHELLFISH IMMUNOLOGY, ISSN:1050-4648, IF: 2.892
FM'99-FORMAL METHODS, VOL II, ISSN:0302-9743
FORMAL METHODS IN SYSTEM DESIGN, ISSN:0925-9856, IF: 1.111
FORMAL TECHNIQUES IN REAL-TIME AND FAULT-TOLERANT SYSTEMS, PROCEEDINGS, ISSN:0302-9743
FOURTH INTERNATIONAL CONFERENCE ON FACTORY 2000 - ADVANCED FACTORY AUTOMATION, ISSN:0537-9989
FRACTALS-COMPLEX GEOMETRY PATTERNS AND SCALING IN NATURE AND SOCIETY, ISSN:0218-348X, IF: 0.5
FULLERENE SCIENCE AND TECHNOLOGY, ISSN:1064-122X
GENE, ISSN:0378-1119, IF: 2.416
GENES and DEVELOPMENT, ISSN:0890-9369, IF: 12.075
GENETICA, ISSN:0016-6707, IF: 2.092
GENETICAL RESEARCH, ISSN:0016-6723, IF: 1.25
GENETICS, ISSN:0016-6731, IF: 3.889
GENETICS SELECTION EVOLUTION, ISSN:0999-193X, IF: 1.402
GENOME, ISSN:0831-2796, IF: 1.709
GEOCHIMICA ET COSMOCHIMICA ACTA, ISSN:0016-7037, IF: 4.385
GEOPHYSICAL RESEARCH LETTERS, ISSN:0094-8276, IF: 3.204
GLYCOBIOLOGY, ISSN:0959-6658, IF: 3.929
HELVETICA CHIMICA ACTA, ISSN:0018-019X, IF: 1.435
HEPATOLOGY, ISSN:0270-9139, IF: 10.84
HEREDITY, ISSN:0018-067X, IF: 4.122
HIGH T(C) SUPERCONDUCTOR THIN FILMS
HUMAN REPRODUCTION, ISSN:0268-1161, IF: 3.859
HYBRID SYSTEMS II, ISSN:0302-9743
HYDROGEOLOGY JOURNAL, ISSN:1431-2174, IF: 1.417
HYDROLOGICAL PROCESSES, ISSN:0885-6087, IF: 1.87
HYPERBOLIC PROBLEMS: THEORY, NUMERICS, APPLICATIONS, VOL 1
HYPERFINE INTERACTIONS, ISSN:0304-3843
ICC 2005: IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS, VOLS 1-5, ISSN:1550-3607
IEEE INFOCOM 2004: THE CONFERENCE ON COMPUTER COMMUNICATIONS, VOLS 1-4, PROCEEDINGS, ISSN:0743-166X

IEEE INFOCOM 2005: THE CONFERENCE ON COMPUTER COMMUNICATIONS, VOLS 1-4, PROCEEDINGS, ISSN:0743-166X
IEEE JOURNAL OF QUANTUM ELECTRONICS, ISSN:0018-9197, IF: 1.968
IEEE TRANSACTIONS ON MAGNETICS, ISSN:0018-9464, IF: 1.061
IEEE TRANSACTIONS ON NEURAL NETWORKS, ISSN:1045-9227, IF: 2.889
IEEE-ACM TRANSACTIONS ON NETWORKING, ISSN:1063-6692, IF: 2.051
IFIP TRANSACTIONS A-COMPUTER SCIENCE AND TECHNOLOGY, ISSN:0926-5473
IGARSS'96 - 1996 INTERNATIONAL GEOSCIENCE AND REMOTE SENSING SYMPOSIUM: REMOTE SENSING FOR A SUSTAINABLE FUTURE, VOLS I - IV
ILLINOIS JOURNAL OF MATHEMATICS, ISSN:0019-2082
IMMUNOGENETICS, ISSN:0093-7711, IF: 2.988
IMMUNOLOGY LETTERS, ISSN:0165-2478, IF: 2.906
IMPACT OF LARGE-SCALE SURVEYS ON PULSATING STAR RESEARCH
INDIAN JOURNAL OF BIOCHEMISTRY and BIOPHYSICS, ISSN:0301-1208, IF: 0.574
INDIAN JOURNAL OF CHEMICAL TECHNOLOGY, ISSN:0971-457X, IF: 0.267
INDIAN JOURNAL OF CHEMISTRY SECTION A-INORGANIC BIO-INORGANIC PHYSICAL THEORETICAL and ANALYTICAL CHEMISTRY, ISSN:0376-4710, IF: 0.617
INDIAN JOURNAL OF ENGINEERING AND MATERIALS SCIENCES, ISSN:0971-4588, IF: 0.218
INDIAN JOURNAL OF PHYSICS AND PROCEEDINGS OF THE INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE-PART B, ISSN:0252-9254, IF: 0.226
INDIAN JOURNAL OF PURE and APPLIED PHYSICS, ISSN:0019-5596, IF: 0.246
INDUSTRIAL and ENGINEERING CHEMISTRY RESEARCH, ISSN:0888-5885, IF: 1.758
INFORMATION PROCESSING '94, VOL I - TECHNOLOGY AND FOUNDATIONS , ISSN:0926-5473
INFORMATION PROCESSING LETTERS, ISSN:0020-0190, If: 0.764
INFORMATION SCIENCES, ISSN:0020-0255, IF: 3.291
INORGANIC CHEMISTRY, ISSN:0020-1669, IF: 4.657
INORGANICA CHIMICA ACTA, ISSN:0020-1693, IF: 2.322
INTEGRATIVE AND INTERDISCIPLINARY ASPECTS OF INTERMETALLICS, ISSN:0272-9172
INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING, ISSN:0029-5981, IF: 2.025
INTERNATIONAL JOURNAL OF CANCER, ISSN:0020-7136, IF: 4.722
INTERNATIONAL JOURNAL OF HYDROGEN ENERGY, ISSN:0360-3199, IF: 3.945
INTERNATIONAL JOURNAL OF MODERN PHYSICS A, ISSN:0217-751X, IF: 0.941
INTERNATIONAL JOURNAL OF MODERN PHYSICS B, ISSN:0217-9792, IF: 0.408
INTERNATIONAL JOURNAL OF ONCOLOGY, ISSN:1019-6439, IF: 2.447
INTERNATIONAL JOURNAL OF PATTERN RECOGNITION AND ARTIFICIAL INTELLIGENCE, ISSN:0218-0014, IF: 0.512
INTERNATIONAL JOURNAL OF PHARMACEUTICS, ISSN:0378-5173, IF: 2.962
INTERNATIONAL JOURNAL OF PHYTOREMEDIATION, ISSN:1522-6514, IF: 1.321
INTERNATIONAL JOURNAL OF QUANTUM CHEMISTRY, ISSN:0020-7608, IF: 1.315
INTERNATIONAL JOURNAL OF REMOTE SENSING, ISSN:0143-1161, IF: 1.089

INTERNATIONAL JOURNAL OF SYSTEMATIC BACTERIOLOGY, ISSN:0020-7713
INVERSE PROBLEMS, ISSN:0266-5611, IF: 1.9
ISIJ INTERNATIONAL, ISSN:0915-1559.902
ISRAELI JOURNAL OF AQUACULTURE-BAMIDGEH, ISSN:0792-156X.313
ISSS'01: 14TH INTERNATIONAL SYMPOSIUM ON SYSTEM SYNTHESIS
JAPANESE JOURNAL OF APPLIED PHYSICS PART 1-REGULAR PAPERS SHORT NOTES and REVIEW PAPERS, ISSN:0021-4922, IF: 1.138
JOURNAL DE PHYSIQUE III, ISSN:1155-4320, IF: 0.756
JOURNAL DE PHYSIQUE IV, ISSN:1155-4339
JOURNAL FUR DIE REINE UND ANGEWANDTE MATHEMATIK, ISSN:0075-4102, IF: 1.079
JOURNAL OF ADHESION, ISSN:0021-8464, IF: 0.688
JOURNAL OF ADHESION SCIENCE AND TECHNOLOGY, ISSN:0169-4243, IF: 1.175
JOURNAL OF ALGEBRA, ISSN:0021-8693, IF:0.632
JOURNAL OF ALLOYS AND COMPOUNDS, ISSN:0925-8388, IF: 2.135
JOURNAL OF APPLIED ELECTROCHEMISTRY, ISSN:0021-891X, IF: 1.697
JOURNAL OF APPLIED PHYSICS, ISSN:0021-8979, IF: 2.072
JOURNAL OF APPLIED POLYMER SCIENCE, ISSN:0021-8995, IF: 1.203
JOURNAL OF BACTERIOLOGY, ISSN:0021-9193, IF: 3.94
JOURNAL OF BIOLOGICAL CHEMISTRY, ISSN:0021-9258, IF: 5.328
JOURNAL OF BIOMOLECULAR STRUCTURE and DYNAMICS, ISSN:0739-1102, IF: 1.124
JOURNAL OF BIOSCIENCES, ISSN:0250-5991, IF: 1.956
JOURNAL OF CATALYSIS, ISSN:0021-9517, IF: 5.288
JOURNAL OF CELL SCIENCE, ISSN:0021-9533, IF: 6.144
JOURNAL OF CHEMICAL PHYSICS, ISSN:0021-9606, IF: 3.093
JOURNAL OF CHEMICAL SCIENCES, ISSN:0253-4134, IF: 0.993
JOURNAL OF CHEMICAL TECHNOLOGY AND BIOTECHNOLOGY, ISSN:0268-2575, IF: 2.045
JOURNAL OF CLIMATE, ISSN:0894-8755, IF: 3.363
JOURNAL OF CLINICAL BIOCHEMISTRY AND NUTRITION, ISSN:0912-0009, IF: 1.672
JOURNAL OF COLLOID AND INTERFACE SCIENCE, ISSN:0021-9797, IF: 3.019
JOURNAL OF COMPUTATIONAL PHYSICS, ISSN:0021-9991, IF: 2.369
JOURNAL OF CONVEX ANALYSIS, ISSN:0944-6532, IF: 0.813
JOURNAL OF DISPERSION SCIENCE AND TECHNOLOGY, ISSN:0193-2691, IF: 0.677
JOURNAL OF ELECTROANALYTICAL CHEMISTRY, ISSN:0022-0728, IF: 2.338
JOURNAL OF EVOLUTIONARY BIOLOGY, ISSN:1010-061X, IF: 3.816
JOURNAL OF FERMENTATION AND BIOENGINEERING, ISSN:0922-338X
JOURNAL OF FISH DISEASES, ISSN:0140-7775, IF: 1.697
JOURNAL OF FLUID MECHANICS, ISSN:0022-1120, IF: 2.283
JOURNAL OF GENERAL VIROLOGY, ISSN:0022-1317, IF: 3.26
JOURNAL OF GENETICS, ISSN:0022-1333, IF: 0.762

JOURNAL OF GENETICS AND GENOMICS, ISSN:1673-8527, IF: 0.813
JOURNAL OF GEOLOGY, ISSN:0022-1376, IF: 2.711
JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES, ISSN:0148-0227, IF: 3.082
JOURNAL OF GEOPHYSICAL RESEARCH-OCEANS, ISSN:0148-0227, IF: 3.082
JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS, ISSN:0148-0227, IF: 3.082
JOURNAL OF HIGH ENERGY PHYSICS, ISSN:1126-6708, IF: 6.019
JOURNAL OF IMMUNOLOGICAL METHODS, ISSN:0022-1759, IF: 2.347
JOURNAL OF IMMUNOLOGY, ISSN:0022-1767, IF: 5.646
JOURNAL OF INVERTEBRATE PATHOLOGY, ISSN:0022-2011, IF: 1.807
JOURNAL OF MACROMOLECULAR SCIENCE-PURE and APPLIED CHEMISTRY, ISSN:1060-1325, IF: 0.792
JOURNAL OF MAGNETISM AND MAGNETIC MATERIALS, ISSN:0304-8853, IF: 1.204
JOURNAL OF MATERIALS CHEMISTRY, ISSN:0959-9428, IF: 4.795
JOURNAL OF MATERIALS RESEARCH, ISSN:0884-2914, IF: 1.667
JOURNAL OF MATERIALS SCIENCE, ISSN:0022-2461, IF: 1.471
JOURNAL OF MATHEMATICAL ANALYSIS AND APPLICATIONS, ISSN:0022-247X, IF: 1.225
JOURNAL OF MATHEMATICAL CHEMISTRY, ISSN:0259-9791, IF: 1.381
JOURNAL OF MATHEMATICAL PHYSICS, ISSN:0022-2488, IF: 1.318
JOURNAL OF MATHEMATICAL PHYSICS ANALYSIS GEOMETRY, ISSN:1812-9471
JOURNAL OF MEDICAL AND VETERINARY MYCOLOGY, ISSN:0268-1218
JOURNAL OF MEMBRANE SCIENCE, ISSN:0376-7388, IF: 3.203
JOURNAL OF MOLECULAR BIOLOGY, ISSN:0022-2836, IF: 3.871
JOURNAL OF MOLECULAR CATALYSIS, ISSN:0304-5102, IF: 3.135
JOURNAL OF MOLECULAR CATALYSIS A-CHEMICAL, ISSN:1381-1169, IF: 3.135
JOURNAL OF MOLECULAR EVOLUTION, ISSN:0022-2844, IF: 2.323
JOURNAL OF MOLECULAR STRUCTURE, ISSN:0022-2860, IF: 1.551
JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY, ISSN:1533-4880, IF: 1.435
JOURNAL OF NATURAL PRODUCTS, ISSN:0163-3864, IF: 3.159
JOURNAL OF NON-CRYSTALLINE SOLIDS, ISSN:0022-3093, IF: 1.252
JOURNAL OF NON-LINEAR OPTICAL PHYSICS and MATERIALS, ISSN:0218-1991, IF: 0.549
JOURNAL OF NUCLEAR MATERIALS, ISSN:0022-3115, IF: 1.933
JOURNAL OF OPTICS A-PURE and APPLIED OPTICS, ISSN:1464-4258, IF: 1.198
JOURNAL OF OPTOELECTRONICS AND ADVANCED MATERIALS, ISSN:1454-4164, IF: 0.433
JOURNAL OF ORGANIC CHEMISTRY, ISSN:0022-3263, IF: 4.219
JOURNAL OF PATHOLOGY, ISSN:0022-3417, IF: 6.466
JOURNAL OF PEPTIDE SCIENCE, ISSN:1075-2617, IF: 1.807
JOURNAL OF PHOTOCHEMISTRY AND PHOTOBIOLOGY A-CHEMISTRY, ISSN:1010-6030, IF: 2.553
JOURNAL OF PHOTOCHEMISTRY AND PHOTOBIOLOGY B-BIOLOGY, ISSN:1011-1344, IF: 1.871
JOURNAL OF PHYSICAL CHEMISTRY, ISSN:0022-3654, IF: 4.224
JOURNAL OF PHYSICAL CHEMISTRY A, ISSN:1089-5639, IF: 2.899

JOURNAL OF PHYSICAL CHEMISTRY B, ISSN:1520-6106, IF: 3.471
JOURNAL OF PHYSICAL CHEMISTRY C, ISSN:1932-7447, IF: 4.224
JOURNAL OF PHYSICS A-MATHEMATICAL AND GENERAL, ISSN:0305-4470
JOURNAL OF PHYSICS A-MATHEMATICAL AND THEORETICAL, ISSN:1751-8113, IF: 1.577
JOURNAL OF PHYSICS AND CHEMISTRY OF SOLIDS, ISSN:0022-3697, IF: 1.189
JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS, ISSN:0953-4075, IF: 1.91
JOURNAL OF PHYSICS D-APPLIED PHYSICS, ISSN:0022-3727, IF: 2.083
JOURNAL OF PHYSICS-CONDENSED MATTER, ISSN:0953-8984, IF: 1.964
JOURNAL OF PLANT PHYSIOLOGY, ISSN:0176-1617, IF: 2.5
JOURNAL OF POLYMER SCIENCE PART A-POLYMER CHEMISTRY, ISSN:0887-624X, IF: 3.971
JOURNAL OF REPRODUCTIVE IMMUNOLOGY, ISSN:0165-0378, IF: 2.519
JOURNAL OF SCIENTIFIC and INDUSTRIAL RESEARCH, ISSN:0022-4456, IF: 0.359
JOURNAL OF SOLID STATE CHEMISTRY, ISSN:0022-4596, IF: 2.34
JOURNAL OF STATISTICAL MECHANICS-THEORY AND EXPERIMENT, ISSN:1742-5468, IF: 2.67
JOURNAL OF STATISTICAL PHYSICS, ISSN:0022-4715, IF: 1.39
JOURNAL OF STRUCTURAL GEOLOGY, ISSN:0191-8141, IF: 1.732
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, ISSN:0002-7863, IF: 8.58
JOURNAL OF THE CHEMICAL SOCIETY-CHEMICAL COMMUNICATIONS, ISSN:0022-4936, IF: 5.504
JOURNAL OF THE CHEMICAL SOCIETY-FARADAY TRANSACTIONS, ISSN:0956-5000, IF: 4.116
JOURNAL OF THE CHEMICAL SOCIETY-PERKIN TRANSACTIONS 1, ISSN:0300-922X
JOURNAL OF THE ELECTROCHEMICAL SOCIETY, ISSN:0013-4651, IF: 2.241
JOURNAL OF THE GEOLOGICAL SOCIETY OF INDIA, ISSN:0016-7622, IF: 0.424
JOURNAL OF THE LESS-COMMON METALS, ISSN:0022-5088
JOURNAL OF THE METEOROLOGICAL SOCIETY OF JAPAN, ISSN:0026-1165, IF: 1.104
JOURNAL OF THE OPTICAL SOCIETY OF AMERICA B-OPTICAL PHYSICS, ISSN:0740-3224, IF: 2.087
JOURNAL OF THERMAL ANALYSIS, ISSN:0368-4466
JOURNAL OF THERMAL BIOLOGY, ISSN:0306-4565, IF: 1.305
JOURNAL OF ZOOLOGICAL SYSTEMATICS AND EVOLUTIONARY RESEARCH, ISSN:0947-5745, IF: 1.85
LAGRANGIAN AND HAMILTONIAN METHODS FOR NONLINEAR CONTROL 2006, ISSN:0170-8643
LANGMUIR, ISSN:0743-7463, IF: 3.898
LECTURES ON THE PHYSICS OF HIGHLY CORRELATED ELECTRON SYSTEMS VIII, ISSN:0094-243X
LETTERS IN MATHEMATICAL PHYSICS, ISSN:0377-9017, IF: 0.969
MACROMOLECULAR CHEMISTRY AND PHYSICS, ISSN:1022-1352, IF: 2.57
MACROMOLECULAR RAPID COMMUNICATIONS, ISSN:1022-1336, IF: 4.263
MACROMOLECULAR SYMPOSIA, ISSN:1022-1360
MACROMOLECULES, ISSN:0024-9297, IF: 4.539
MATERIALS RESEARCH BULLETIN, ISSN:0025-5408, IF: 1.879
MATERIALS RESEARCH INNOVATIONS, ISSN:1432-8917, IF: 1.723
MATERIALS SCIENCE AND ENGINEERING A-STRUCTURAL MATERIALS PROPERTIES MICROSTRUCTURE AND PROCESSING, ISSN:0921-5093, IF: 1.901

MATERIALS SCIENCE AND ENGINEERING B-SOLID STATE MATERIALS FOR ADVANCED TECHNOLOGY, ISSN:0921-5107, IF: 1.756
MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE 2003, PROCEEDINGS, ISSN:0302-9743
MATHEMATICS OF COMPUTATION, ISSN:0025-5718, IF: 1.598
MATHEMATISCHE ANNALEN, ISSN:0025-5831, IF: 1.198
MEASUREMENT SCIENCE and TECHNOLOGY, ISSN:0957-0233, IF: 1.317
METALLURGICAL AND MATERIALS TRANSACTIONS A-PHYSICAL METALLURGY AND MATERIALS SCIENCE, ISSN:1073-5623, IF: 1.564
METALS MATERIALS AND PROCESSES, ISSN:0970-423X
METHODS IN MOLECULAR AND CELLULAR BIOLOGY, ISSN:0898-7750
MICROBIOLOGY-SGM, ISSN:1350-0872, IF: 3.025
MICROPOROUS AND MESOPOROUS MATERIALS, ISSN:1387-1811, IF: 2.652
MODERN PHYSICS LETTERS A, ISSN:0217-7323, IF: 1.075
MODERN PHYSICS LETTERS B, ISSN:0217-9849, IF: 0.512
MOLECULAR AND GENERAL GENETICS, ISSN:0026-8925
MOLECULAR BIOLOGY AND EVOLUTION, ISSN:0737-4038, IF: 9.872
MOLECULAR CRYSTALS AND LIQUID CRYSTALS SCIENCE AND TECHNOLOGY SECTION A-MOLECULAR CRYSTALS AND LIQUID CRYSTALS, ISSN: 1058-725X
MOLECULAR ECOLOGY, ISSN:0962-1083, IF: 5.96
MOLECULAR MICROBIOLOGY, ISSN:0950-382X, IF: 5.361
MOLECULAR PHARMACEUTICS, ISSN:1543-8384, IF: 5.408
MONATSHFTE FUR MATHEMATIK, ISSN:0026-9255, IF: 0.764
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY, ISSN:0035-8711, IF: 5.103
MYCOPATHOLOGIA, ISSN:0301-486X, IF: 1.728
NANOTECHNOLOGY, ISSN:0957-4484, IF: 3.137
NATURE, ISSN:0028-0836, IF: 34.48
NATURE IMMUNOLOGY, ISSN:1529-2908, IF: 26.000
NETWORK CONTROL AND OPTIMIZATION, ISSN:0302-9743
NETWORKING 2005: NETWORKING TECHNOLOGIES, SERVICES, AND PROTOCOLS; PERFORMANCE OF COMPUTER AND COMMUNICATION NETWORKS; MOBILE AND WIRELESS COMMUNICATIONS SYSTEMS, ISSN:0302-9743
NEW JOURNAL OF PHYSICS, ISSN:1367-2630, IF: 3.312
9TH INTERNATIONAL WORKSHOP ON FRONTIERS IN HANDWRITING RECOGNITION, PROCEEDINGS
NON-STOICHIOMETRY IN SEMICONDUCTORS
NUCLEAR INSTRUMENTS and METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS, ISSN:0168-583X, IF: 1.156
NUCLEAR PHYSICS A, ISSN:0375-9474, IF: 1.706
NUCLEAR PHYSICS B, ISSN:0550-3213, IF: 4.341
NUCLEAR PHYSICS B-PROCEEDINGS SUPPLEMENTS, ISSN:0920-5632
OIKOS, ISSN:0030-1299, IF: 3.147
ONCOGENE, ISSN:0950-9232, IF: 7.135

OPTICS COMMUNICATIONS, ISSN:0030-4018, IF: 1.316
OPTICS EXPRESS, ISSN:1094-4087, IF: 3.278
OPTICS LETTERS, ISSN:0146-9592, IF: 3.059
ORAL ONCOLOGY, ISSN: ORAL ONCOLOGY, IF: 3.123
ORGANIC and BIOMOLECULAR CHEMISTRY, ISSN:1477-0520, IF: 3.762
ORGANIC LETTERS, ISSN:1523-7060, IF: 5.42
PALEOCEANOGRAPHY, ISSN:0883-8305, IF: 3.644
PARASITOLOGY INTERNATIONAL, ISSN:1383-5769, IF: 1.701
PARASITOLOGY RESEARCH, ISSN:0932-0113, IF: 1.721
PATTERN RECOGNITION, ISSN:0031-3203, IF: 2.554
PERFORMANCE CHALLENGES FOR EFFICIENT NEXT GENERATION NETWORKS, VOLS 6A-6C
PHASE TRANSITIONS, ISSN:0141-1594, IF: 0.935
PHILOSOPHICAL MAGAZINE A-PHYSICS OF CONDENSED MATTER STRUCTURE DEFECTS AND MECHANICAL PROPERTIES, ISSN:0141-8610, IF: 1.273
PHILOSOPHICAL MAGAZINE LETTERS, ISSN:0950-0839, IF: 1.53
PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A-MATHEMATICAL PHYSICAL AND ENGINEERING SCIENCES, ISSN:1364-503X, IF: 2.295
PHOTOCHEMISTRY AND PHOTOBIOLOGY, ISSN:0031-8655, IF: 2.253
PHOTONICS AND NANOSTRUCTURES-FUNDAMENTALS AND APPLICATIONS, ISSN:1569-4410, IF: 2.131
PHYSICA A, ISSN:0378-4371, IF: 1.562
PHYSICA A-STATISTICAL MECHANICS AND ITS APPLICATIONS, ISSN:0378-4371, IF: 1.562
PHYSICA B, ISSN:0921-4526, IF: 1.056
PHYSICA C, ISSN:0921-4534, IF: 0.723
PHYSICA SCRIPTA, ISSN:0281-1847, IF: 1.088
PHYSICA STATUS SOLIDI A-APPLICATIONS AND MATERIALS SCIENCE, ISSN:0031-8965, IF: 1.228
PHYSICA STATUS SOLIDI B-BASIC RESEARCH, ISSN:0370-1972, IF: 1.15
PHYSICA STATUS SOLIDI C - CURRENT TOPICS IN SOLID STATE PHYSICS, VOL 6, NO 10, ISSN:1610-1634
PHYSICAL BIOLOGY, ISSN:1478-3967, IF: 3.086
PHYSICAL CHEMISTRY CHEMICAL PHYSICS, ISSN:1463-9076, IF: 4.116
PHYSICAL REVIEW A, ISSN:1050-2947, IF: 2.866
PHYSICAL REVIEW B, ISSN:1098-0121, IF: 3.475
PHYSICAL REVIEW D, ISSN:1550-7998, IF: 4.922
PHYSICAL REVIEW E, ISSN:1539-3755, IF: 2.4
PHYSICAL REVIEW LETTERS, ISSN:0031-9007, IF: 7.328
PHYSICS AND CHEMISTRY OF THE EARTH PART A-SOLID EARTH AND GEODESY, ISSN:1464-1895, IF: 0.975
PHYSICS LETTERS A, ISSN:0375-9601, IF: 2.009
PHYSICS LETTERS B, ISSN:0370-2693, IF: 5.083
PHYSICS OF FLUIDS, ISSN:1070-6631, IF: 1.638
PHYSICS OF PLASMAS, ISSN:1070-664X, IF: 2.475
PHYSICS REPORTS-REVIEW SECTION OF PHYSICS LETTERS, ISSN:0370-1573, IF: 17.752

PLANT AND SOIL, ISSN:0032-079X, IF: 2.517
PLANT CELL, ISSN:1040-4651, IF: 9.293
PLANT CELL REPORTS, ISSN:0721-7714, IF: 2.301
PLANT CELL TISSUE AND ORGAN CULTURE, ISSN:0167-6857, IF: 1.271
PLANT DISEASE, ISSN:0191-2917, IF: 2.121
PLANT GROWTH REGULATION, ISSN:0167-6903, IF: 1.53
PLANT JOURNAL, ISSN:0960-7412, IF: 6.946
PLANT PHYSIOLOGY, ISSN:0032-0889, IF: 6.235
PLANT SCIENCE, ISSN:0168-9452, IF: 2.05
PLANTA MEDICA, ISSN:0032-0943, IF: 2.037
PLOS GENETICS, ISSN:1553-7390, IF: 9.532
PLOS ONE, ISSN:1932-6203, IF: 4.351
POLYHEDRON, ISSN:0277-5387, IF: 2.207
POLYMER, ISSN:0032-3861, IF: 3.573
POLYMER AND OTHER ADVANCED MATERIALS: EMERGING TECHNOLOGIES AND BUSINESS OPPORTUNITIES
POLYMER INTERNATIONAL, ISSN:0959-8103, IF: 2.137
POLYMER JOURNAL, ISSN:0032-3896, IF: 1.386
POLYMER-SOLVENT COMPLEXES AND INTERCALATES V, ISSN:0258-0322
POWDERS AND GRAINS 2009, ISSN:0094-243X
PRAMANA-JOURNAL OF PHYSICS, ISSN:0304-4289, IF: 0.349
PRECAMBRIAN RESEARCH, ISSN:0301-9268, IF: 3.581
PROBABILITY IN THE ENGINEERING AND INFORMATIONAL SCIENCES, ISSN:0269-9648, IF: 0.676
PROCEEDINGS OF THE AMERICAN MATHEMATICAL SOCIETY, ISSN:2936217, IF: 0.64
PROCEEDINGS OF THE 11TH THEMATIC CONFERENCE - GEOLOGIC REMOTE SENSING: PRACTICAL SOLUTIONS FOR REAL WORLD PROBLEMS, VOL II, ISSN:1067-0106
PROCEEDINGS OF THE INDIAN ACADEMY OF SCIENCES-CHEMICAL SCIENCES, ISSN:0253-4134, IF: 0.993
PROCEEDINGS OF THE INDIAN ACADEMY OF SCIENCES-MATHEMATICAL SCIENCES, ISSN:0253-4142, IF: 0.382
PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA, ISSN:0027-8424, IF: 9.432
PROCEEDINGS OF THE ROYAL SOCIETY OF EDINBURGH SECTION A-MATHEMATICS, ISSN:0308-2105, IF: 0.694
PROCEEDINGS OF THE THIRD INTERNATIONAL SYMPOSIUM ON MODELLING AND OPTIMIZATION IN MOBILE, AD HOC, AND WIRELESS NETWORKS
PROCEEDINGS OF THE XVI INTERNATIONAL CANCER CONGRESS - FREE PAPERS AND POSTERS, TOMES 1-4
PROGRESS IN NATURAL SCIENCE, ISSN:1002-0071, IF: 0.704
PROTEIN EXPRESSION AND PURIFICATION, ISSN:1046-5928, IF: 1.563
PROTEINS-STRUCTURE FUNCTION AND GENETICS, ISSN:0887-3585, IF: 3.085
QUANTUM COMMUNICATION, MEASUREMENT AND COMPUTING, PROCEEDINGS
QUANTUM ELECTRONICS, ISSN:1063-7818, IF: 0.791

QUATERNARY RESEARCH, ISSN:0033-5894, IF: 2.675
RADIATION MEASUREMENTS, ISSN:1350-4487, IF: 0.973
RAIRO-MATHEMATICAL MODELLING AND NUMERICAL ANALYSIS-MODELISATION MATHEMATIQUE ET ANALYSE NUMERIQUE, ISSN:0764-583X, IF: 1.483
REACTION KINETICS AND CATALYSIS LETTERS, ISSN:0133-1736.557
RECENT ADVANCES IN BASIC AND APPLIED ASPECTS OF INDUSTRIAL CATALYSIS, ISSN:0167-2991
RESEARCH AND INDUSTRY, ISSN:0034-513X
RESEARCH IN MICROBIOLOGY, ISSN:0923-2508, IF: 2.154
RESEARCH IN VIROLOGY, ISSN:0923-2516
RESEARCH ON CHEMICAL INTERMEDIATES, ISSN:0922-6168, IF: 0.813
RNA-A PUBLICATION OF THE RNA SOCIETY, ISSN:1355-8382, IF: 5.198
RUBBER CHEMISTRY AND TECHNOLOGY, ISSN:0035-9475, IF: 0.635
SADHANA-ACADEMY PROCEEDINGS IN ENGINEERING SCIENCES, ISSN:0256-2499, IF: 0.196
SCIENCE, ISSN:0036-8075, IF: 29.747
SCRIPTA MATERIALIA, ISSN:1359-6462, IF: 2.949
SCRIPTA METALLURGICA ET MATERIALIA, ISSN:0956-716X, IF: 2.949
SEDIMENTOLOGY, ISSN:0037-0746, IF: 2.114
SEPARATION AND PURIFICATION TECHNOLOGY, ISSN:1383-5866, IF: 2.879
SIAM JOURNAL ON APPLIED MATHEMATICS, ISSN:0036-1399, IF: 1.639
SMALL, ISSN:1613-6810, IF: 6.171
SMART MATERIALS, STRUCTURES, AND SYSTEM, PTS 1 AND 2, ISSN:0277-786X
SOLID STATE COMMUNICATIONS, ISSN:0038-1098, IF: 1.837
SOLID STATE IONICS, ISSN:0167-2738, IF: 2.162
SOLID STATE NUCLEAR MAGNETIC RESONANCE, ISSN:0926-2040, IF: 1.368
SURFACE SCIENCE, ISSN:0039-6028, IF: 1.798
SYMPOSIUM ON LOGIC IN COMPUTER SCIENCE - LICS '94, PROCEEDINGS, ISSN:1043-6871
SYNLETT, ISSN:0936-5214, IF: 2.718
SYNTHETIC COMMUNICATIONS, ISSN:0039-7911, IF: 0.961
SYNTHETIC METALS, ISSN:0379-6779, IF: 1.901
SYSTEMS and CONTROL LETTERS, ISSN:0167-6911, IF: 1.797
TECTONICS, ISSN:0278-7407, IF: 3.287
TETRAHEDRON, ISSN:0040-4020, IF: 3.219
TETRAHEDRON LETTERS, ISSN:0040-4039, IF: 2.66
THEORETICAL AND APPLIED GENETICS, ISSN:0040-5752, IF: 3.363
THEORETICAL CHEMISTRY ACCOUNTS, ISSN:1432-881X, IF: 2.584
THEORETICAL COMPUTER SCIENCE, ISSN:0304-3975, IF: 0.943
THIN SOLID FILMS, ISSN:0040-6090, IF: 1.727
TOPOLOGY, ISSN:0040-9383, IF: 0.816
TRENDS IN MICROBIOLOGY, ISSN:0966-842X, IF: 6.894

TRENDS IN NDE SCIENCE AND TECHNOLOGY - PROCEEDINGS OF THE 14TH WORLD CONFERENCE ON NDT (14TH WCNDT), VOLS 1-5

TUBERCULOSIS, ISSN:1472-9792, IF: 2.536

ULTRASONICS SONOCHEMISTRY, ISSN:1350-4177, IF: 2.993

UNSOLVED PROBLEMS OF THE MILKY WAY, ISSN:0074-1809

VACCINE, ISSN:0264-410X, IF: 3.616

VIBRATIONAL SPECTROSCOPY, ISSN:0924-2031, IF: 1.931

VIRUS RESEARCH, ISSN:0168-1702, IF: 2.563

VLSI DESIGN 2001: 14TH INTERNATIONAL CONFERENCE ON VLSI DESIGN

WIRELESS NETWORKS, ISSN:1022-0038, IF: 1.088

WIRELESS SYSTEMS AND MOBILITY IN NEXT GENERATION INTERNET, ISSN:0302-9743

WORLD JOURNAL OF MICROBIOLOGY AND BIOTECHNOLOGY, ISSN:0959-3993, IF: 1.082

ZEITSCHRIFT FUR KRISTALLOGRAPHIE-NEW CRYSTAL STRUCTURES, ISSN:1433-7266, IF: 0.221

ZEOLITES, ISSN:0144-2449

ZEOLITES AND RELATED MICROPOROUS MATERIALS: STATE OF THE ART 1994

Annexure XI:

Subject-wise Distribution of Papers

Year	Papers	Citations Received	Total IF	Impact Energy
Biotechnology				
2004	2	45	11.762	69.172
2005	2	54	12.577	110.177
2006	3	35	11.828	52.719
2008	1	4	3.322	11.036
2009	1	2	5.408	29.246
Computer and Information Science				
1990	1	13	0.331	0.110
1992	4	1	0.337	0.083
1993	2	15	1.75	3.045
1994	4	5	0.01	0.000
1995	1	0	0	0.000
1996	1	0	0.207	0.043
1997	1	7	0	0.000
1998	4	10	0	0.000
1999	5	28	2.677	1.729
2000	3	2	1.063	0.410
2001	3	1	0	0.000
2002	3	34	1.044	0.452
2003	2	26	0	0.000
2004	1	0	0	0.000
2005	1		0	0.000
2007	1	0	0	0.000
Earth and Planetary sciences				
1995	2	116	4.855	12.359
1996	1	43	1.258	1.583
1998	2	56	4.835	12.634
2000	1	99	2.126	4.520
2001	2	47	2.643	5.346
2002	1	11	2.697	7.274
2003	1	23	1.243	1.545

Year	Papers	Citations Received	Total IF	Impact Energy
2004	1	22	1.61	2.592
2005	1	0	2.491	6.205
2006	1	1	0.737	0.543
2007	3	18	10.846	41.620
2008	2	16	6.296	19.820
2009	2	1	7.144	25.999
Environmental Sciences				
1999	2	86	4.665	11.380
2000	2	32	5.533	17.202
2001	2	105	4.402	10.022
2002	2	19	5.193	13.535
2003	3	64	5.029	8.547
2005	2	10	1.922	2.061
2006	1	12	3.381	11.431
2008	2	0	3.899	8.369
2009	1	0	3.94	15.524
Instrumentation				
1994	2	8	0.23	0.026
1995	3	33	4.134	10.101
1996	5	36	1.812	3.283
1997	3	13	1.551	0.996
1998	1	4	0.886	0.785
Life and Health Sciences				
1990	1	62	3.557	12.652
1991	2	35	2.38	4.784
1992	5	86	20.076	162.040
1993	12	260	25.343	93.660
1994	5	60	7.945	19.268
1995	14	558	33.291	131.113
1996	14	291	21.324	50.383
1997	10	149	16.062	51.321
1998	16	416	34.764	116.198
1999	17	385	35.789	105.005
2000	9	202	21.636	64.267
2001	7	276	23.996	153.573
2002	10	866	48.25	336.963
2003	6	106	24.524	156.305
2004	14	507	76.66	562.498

Year	Papers	Citations Received	Total IF	Impact Energy
2005	6	69	19.953	84.563
2006	9	40	14.182	27.513
2007	15	115	51.322	267.175
2008	16	55	52.028	245.614
2009	11	45	71.603	980.626
Material Sciences				
1990	3	15	4.669	7.652
1991	3	6	1.96	1.967
1992	13	166	16.133	29.068
1993	25	442	32.687	58.137
1994	23	824	54.015	171.578
1995	16	318	19.993	32.083
1996	20	282	26.894	48.900
1997	19	512	30.39	62.514
1998	19	651	29.25	62.779
1999	16	364	26.026	53.833
2000	3	31	5.422	10.025
2001	2	10	4.416	11.237
2002	7	62	10.622	21.030
2003	8	17	9.489	21.947
2004	9	156	19.85	56.154
2005	19	102	46.314	143.873
2006	3	8	6.961	20.865
2007	1	4	3.172	10.062
2008	2	9	4.892	17.753
2009	18	26	62.981	318.038
Pure and Applied Chemistry				
1990	3	127	8.728	58.852
1991	7	81	10.032	20.947
1992	7	104	17.097	73.219
1993	9	237	16.348	38.584
1994	21	415	59.604	280.889
1995	17	378	70.396	910.572
1996	21	661	48.285	133.725
1997	16	298	41.839	120.722
1998	22	792	44.061	131.440
1999	9	338	17.129	42.304
2000	8	328	22.349	106.216

Year	Papers	Citations Received	Total IF	Impact Energy
2001	7	120	17.623	65.103
2002	30	483	59.981	175.024
2003	16	263	47.469	157.524
2004	13	315	34.776	104.819
2005	9	48	18.293	45.141
2006	18	209	49.2	151.080
2007	8	54	21.176	60.270
2008	10	45	33.806	186.520
2009	7	29	46.433	547.998
Pure and Applied Mathematics				
1993	2	2	0	0.000
1995	1	9	0.61	0.372
1996	5	34	3.738	3.474
1997	6	95	5.462	5.891
1998	3	23	2.017	2.498
1999	4	10	3.825	4.923
2000	5	24	3.623	2.878
2001	3	26	3.459	4.896
2002	4	22	1.986	1.687
2003	3	7	1.784	2.285
2004	4	13	1.862	0.877
2005	3	10	1.96	1.666
2006	2	17	1.427	1.061
2007	2	5	2.722	5.749
2009	7	4	10.335	18.744
Pure and Applied Physics				
1990	3	40	7.176	17.378
1992	6	130	11.946	27.490
1993	5	114	7.494	13.692
1994	2	75	4.656	10.839
1995	2	6	2.386	2.846
1996	5	11	2.054	3.034
1997	3	28	5.284	9.688
1998	6	158	21.284	96.589
1999	11	435	35.059	293.679
2000	14	318	61.156	805.892
2001	13	172	43.115	182.770
2002	20	218	61.72	248.323

Year	Papers	Citations Received	Total IF	Impact Energy
2003	20	282	36.119	110.039
2004	24	764	100.004	509.735
2005	21	557	95.539	478.810
2006	22	254	73.279	313.845
2007	45	356	164.591	1,277.363
2008	39	309	153.315	1,499.785
2009	33	56	111.945	649.322
Technology for Information and Communication				
2004	2	0	0	0.000
2005	12	104	3.833	6.957
2006	9	116	6.779	12.414
2007	5	27	5.197	9.061
2008	1	2	2.576	6.636
2009	1	0	0	0.000
Water				
2002	1	145	3.123	9.753
2003	3	23	1.754	1.097
2004	1	1	0.345	0.119
2006	1	1	1.288	1.659
2007	1	5	1.346	1.812
2008	1	8	2.002	4.008
Total	1,169	20,086	2,924.295	15,391.124

Annexure XII:

Project-wise Distribution of Papers

Project	Papers	Impact Factor	Impact Energy	Citations Received
Biotechnology				
Role of glutathione transporters in stress tolerance (2700–B1)	3	3	74.676	56
Catalytic antibodies against factor VIII structure, function and implication for therapy. (2800–B1)	2	2	110.205	50
Synthesis and structural studies of N-glycoprotein analogs. (3200–B1)	2	2	47.187	28
Targeted delivery of RNAi using synthetic vectors for gene therapy of head and neck squamous cell carcinomas (3700–B1)	2	2	40.282	6
Biotechnology Total	9	9	272.351	140
Computer and Information Science				
Modelling and design of automated manufacturing systems (1002–1)	1	1	0.000	0
Study of higher dimensional grammars and picture languages (102–1)	2	2	0.191	14
Specifications and verification of distributed systems: The finite state and higher-order cases (1502–1)	8	8	0.618	61
Automata, infinite words, and codes (1602–1)	4	4	1.363	4
CORCoP: Compilation and optimization for reconfigurable co-processors (1802–1)	2	2	0.000	1
Automata and concurrency: Suntactic methods for verifications (2102–1)	3	3	0.265	38
Formal specifications and verification of hybrid and reactive systems (2202–1)	3	3	0.345	4
Handwriting recognition for postal automation (2702–1)	2	2	0.000	0
A formal model for task execution in a real time distributed computing systems (302–1)	6	6	3.088	15
Modelling and controller synthesis for mechanical systems with fluids and flexible elements (3602–1)	1	1	0.000	0
Partial order models and logics for concurrency (502–1)	1	1	0.000	5

Project	Papers	Impact Factor	Impact Energy	Citations Received
Formal specifications and development of real time reactive programs (502–2)	4	4	0.001	0
Computer and Information Science Total	37	37	5.871	142
Earth and Planetary Sciences				
Archaean Lithosphere in south India (1111–1)	7	7	26.800	353
Accretionary processes of juvenile crust and continental growth: the late Archaean eastern Dharwar craton (2307–1)	1	1	7.274	11
Sensitivity of the Indian summer monsoon to anthropogenic climate change (2407–1)	1	1	1.545	23
Evaluation and validation of systems of assimilation (2707–1)	1	1	6.205	0
Ionospheric perturbations linked to seismic activity (2807–1)	2	2	3.135	23
Oxygen isotopic anomaly from ozone to other trace molecules (3207–1)	4	4	51.379	30
Deciphering history of the Indo-Eurasia collision from detailed plate tectonics of the Indian ocean (3307–1)	1	1	16.500	1
Palaeomagnetism of great DYKE and vindhyan super group rocks of India (3607–1)	1	1	10.062	4
Multi-scale interactions and predictability of the Indian summer monsoon (3907–1)	1	1	9.499	0
Sensitivity of monsoonal climate to modelling of clouds and land surface processes (711–1)	1	1	9.641	8
Earth and Planetary sciences Total	20	20	142.039	453
Environmental Sciences				
Reconstruction of the changes in the oxygen minimum of the Arabian Sea during the late quaternary links with the monsoon (1809–1)	7	7	48.924	174
Study on factors prevailing for the selection of mycorrhizal strains in ash pond (2109–1)	3	3	3.830	10
Water and liquid effluent treatment: Role of cavitation (2209–1)	3	3	7.940	103
Biodiversity and function of bacteria from Antarctica pack ice and sea water (2409–1)	2	2	15.253	41
Bioremediation of trace cobalt from simulated spent decontaminatin solutions of nuclear power reactors usong E-coli expressing NiCoT genes (3709–1)	2	2	22.123	0
Environmental Sciences Total	17	17	98.070	328

Project	Papers	Impact Factor	Impact Energy	Citations Received
Instrumentation				
Surface and thin film characterization by mirage spectroscopy (208–1)	13	13	14.289	93
Use of Laser Heterodyne system with AOS for atmospheric studies at tropical latitude (811–1)	1	1	0.903	1
Instrumentation Total	14	14	15.192	94
Life and Health Sciences				
Molecular biology of the silk work: Use of genetic engineering for biotechnology applications (103–1)	6	6	207.207	69
Interaction of aflatoxin B1 and hepatitis B virus in the pathogenesis of hepto-cellular carcinoma:studies using duck hepatitis B virus animal model (104–1)	3	3	39.237	40
Ecological and evolutionary genetics of Indian drosophila (1103–1)	21	21	91.706	506
Mapping of the brassica genomes (1203–1)	5	5	15.993	119
Evaluation of the effects of post-transcriptional modifications on the biological functions of E.coli tr RNA-SER(GGA) (1203–2)	4	4	63.263	30
Osmotic regulation of proU trnscription and interactio;n of nucleoid protein H-NS with DNA in Escherichia coli: in vitro studies (1303–1)	1	1	27.447	11
Study of genetic alterations in precancerous and cancerous oral lesions (1403–1)	4	4	30.808	150
Transregulation of homeotic gense in drosophila-targetted genetic screens and molecular characterization (1603–1)	3	3	62.839	72
Cytokines and integrins in successful implantation and parturition (1604–1)	5	5	30.401	256
Genetic engineering of egg plant for disease resistance (1803–1)	1	1	0.398	24
A computer based search for the principles of protein-DNA recognition (1804–1)	9	9	251.424	269
Molecular analysis of the functional role of palmitoylation of human erythrocyte membrane prote in 4.2 (1903–1)	3	3	129.119	112
Osmoregulation in Azopirillum: Molecular basis and Metabolic engineering (2003–1)	4	4	18.791	18
RNA editing as a molecular tool to generate cytoplasmic male sterie lines in rice (2003–4)	1	1	118.723	110
Prognostic values of cytokines in cervical cancer (2004–1)	3	3	12.506	45

Project	Papers	Impact Factor	Impact Energy	Citations Received
Molecular characterization of levan sucrase gene of <i>Zymomonas mobilis</i> (203–1)	5	5	19.889	112
Immunoregulation at the maternal-fetal interface and its applications (204–1)	9	9	94.896	582
Signal transduction in stomatal guard cells (2203–1)	7	7	328.178	525
Analysis of protein-protein association in crystals and complexes (2203–2)	2	2	47.491	394
DNA transcription in an artificial nucleus (2303–1)	2	2	20.455	22
Characterization of membrane proteins from, <i>M. Tuberculosis</i> (2303–2)	1	1	0.000	17
Identification of <i>Mycobacterium tuberculosis</i> genes (2403–1)	1	1	9.672	10
Pharmacogenetics of Busulfan and cyclophosphamide (2403–2)	1	1	95.688	42
Protein transport in <i>Plasmodium falciparum</i> erythrocytes (2503–1)	2	2	75.896	42
Production of pharmaceuticals through genetic transformation (2503–2)	4	4	12.810	31
Development of reliable transformation system for improvement of coffee (2603–1)	1	1	0.904	4
Injectable adhesive biomaterials for vascular applications (2603–2)	2	2	15.875	19
Basulovirus resistance in transgenic silkworms (2603–3)	1	1	1.124	6
Occurrence of mutations in non-dividing cells of <i>Escherichia coli</i> (2703–1)	4	4	99.572	80
Protein properties in salt and nucleic acid solutions (2803–1)	3	3	45.439	41
Study of epithelial morphogenesis development (2903–1)	1	1	42.811	6
Searching link between pairing dependent silencing and co-suppression (2903–2)	1	1	18.396	22
Design, parallel synthesis and evaluation of glucosamine-6-pyrophosphate targeted inhibitors (3003–1)	5	5	34.083	32
Studies on plant tRNAs and tRNA genes (303–1)	3	3	1.974	10
<i>Candida albicans</i> membrane composition and liposomal amphotericin B antifungal activity: physico-chemical studies (304–1)	3	3	9.219	48
Study on virus (MrNV/XSV and WSSV) pathogenic to <i>Macrobrachium rosebergii</i> in India (3103–1)	8	8	31.578	32
Hox- and Ecdysone targets in heart and muscle remodelling (3203–1)	2	2	76.056	13

Project	Papers	Impact Factor	Impact Energy	Citations Received
Structural and functional diversity of PcG complexes (3303–1)	6	6	334.218	47
The regulation of nutrient uptake by rab GTP Cases in two pathogenic human parasites, Leishmania and Plasmodia (3303–3)	1	1	87.984	1
Leishmania infection in new inbred mouse strains (3303–4)	2	2	707.877	15
Transcriptome, MDR transcription regulators and micro arrays of human pathogen Candida (3403–2)	3	3	47.455	27
Analysis of GPLs biosynthesis in Mycobacteria (3403–3)	2	2	13.967	9
Isolation and characterization of biologically active saponins from chlorophytum species (3403–4)	4	4	19.185	5
Characterization of LmSIR2 and search for target specific inhibitors (3603–1)	5	5	18.822	25
Studies on the regulation of p53 mRNA translation (3703–1)	3	3	84.586	21
Study of breast cancer in high risk ethnic groups (404–2)	8	8	19.138	84
Catalytic antibodies in immune-mediated disorders (4103–2)	2	2	19.283	1
Studies on ecology, molecular biology and genetics of frankia, an actinorrhizal nitrogen fixing microsymbiont (603–1)	7	7	46.083	250
Structure-function relationship of viral proteins and their use in obtaining transgenic plants resistant to viral infection (603–2)	9	9	25.224	90
Indian mice as new genetical models in immunology : Tools for the study of immune tolerance (704–1)	3	3	14.359	66
Eukaryotic DNA topoisomerase I inhibitors as antitumoral agents: Synthesis and biological evaluation of analogues of an active Indoloquinoline (704–2)	1	1	5.094	18
Structural and fundamental studies on enhancing factor gene (803–1)	2	2	0.378	3
Life and Health Sciences Total	199	199	3,625.521	4,583
Material Sciences				
Side chain liquid crystalline polymers for nonlinear optical applications: synthesis, characterization and measurements (1008–1)	7	7	21.188	97
Study of magnetic thin films for recording appliances (108–1)	7	7	15.177	60

Project	Papers	Impact Factor	Impact Energy	Citations Received
Fundamental and applied aspects of Portevin-Le-Chatelier effect-Chaos and fracture (1108-1)	5	5	6.992	66
Electrodeposition and investigation of low cost polycrystalline thin films of II-VI semiconductors for solar energy conversion (1108-2)	5	5	12.784	125
Polyarylene sulphides : synthesis, characterization and processing (1108-3)	5	5	12.319	34
Ion beam induced phase and property modifications in advanced ceramics (1208-1)	9	9	25.565	155
Investigations of oxidic and metallic nanomaterials (1308-1)	11	11	29.865	970
Novel layered and framework metal oxides, synthesis and investigation of structure, properties and reactivity (1308-3)	15	15	76.434	194
Chemistry and physics of molecular-based materials (1308-4)	5	5	20.729	137
Influence of the surface energetics of the reinforcement on the development of microstructure of the matrix and fiber/matrix interactions in composites (1408-1)	1	1	2.941	1
Development of ionic ferromagnetic fluids (1508-2)	5	5	16.703	73
Exploring self-organised criticality in a granular medium (1508-3)	2	2	6.070	5
Clusters and cluster assembled materials (1508-4)	1	1	0.526	21
Solid-state supramolecular chemistry applied to the designing of non-linear optical materials (1708-1)	3	3	10.737	26
Investigations of superconductivity and magnetism in the newly discovered quaternary rare earth transition metal borocarbides (1808-1)	8	8	36.506	55
Influences of impurities in correlated electron systems (2208-1)	2	2	10.519	14
Mathematical modelling and simulation of the characteristics of laminated smart composite structures (2308-1)	2	2	0.000	0
Deformation behaviour of lamellar intermetallic alloys (2308-2)	7	7	11.499	50
Novel hydrophobically modified polymers: synthesis, characterisation and rheology (2508-1)	1	1	4.456	2
Radiation induced electronic phase separation in epitaxial films perovskite manganates (2808-1)	14	14	126.282	154
Polymer materials with multiscale porosity (2808-2)	9	9	70.343	52

Project	Papers	Impact Factor	Impact Energy	Citations Received
Generation of nanophases particles by energetic ion beams (2808–3)	6	6	11.965	45
Advanced materials: Superconductors and semiconductors by laser Raman spectroscopy (308–1)	11	11	17.171	67
Ion Beam and laser processing of advanced ceramics and related synthesis of thin films (308–2)	7	7	27.596	112
Processes and products research on the production, design, and developments of new materials by chimie douce (308–3)	6	6	19.261	167
Laser spectroscopy research in solid state ionics (308–4)	3	3	1.890	10
Reinforcement of elastomers by fillers (308–5)	7	7	6.991	82
Thermal and photochemical degradation and stabilization of polymer blends and alloys (308–6)	5	5	3.118	32
A study of transport and self diffusivity within zeolites (3408–2)	1	1	12.048	2
Spin transition in Fe(II) and Cyano bridged molecular magnets (3408–3)	3	3	38.723	10
Crystal growth and studies of new magnetic compounds (3408–4)	1	1	53.700	4
Novel magnetic ground states of low-dimensional systems (3508–2)	2	2	63.761	7
Self-Organized nanostructures at surfaces (3608–2)	6	6	72.316	7
Photomagnetic investigations on magnetic oxides (3708–1)	2	2	33.309	2
Orientation dependent recovery in metallic materials (3808–1)	4	4	15.693	4
Atomistic studies of supported metal oxide nanosystems (3808–2)	2	2	56.302	3
Novel in-situ second phase whisker formation reactions in ceramic matrices and repairation of ceramic matrixceramic whisker reinforced composites from such powders (408-1)	3	3	3.438	10
The new ceramic oxide high temperature super conductors and their properties (408-2)	3	3	31.844	25
Preparation and characterization of thin films of perovskites for the electrocatalysis of oxygen (408-3)	8	8	16.908	188
Studies on the halogen inter-calated carbons (508-1)	5	5	9.940	67
Investigations of magnetic mixed valence, and superconducting properties of transition metal-intermetallic compounds and oxides of rare earths (509-1)	12	12	109.728	854

Project	Papers	Impact Factor	Impact Energy	Citations Received
Redox mechanisms in high T _c superconductors and search for new copper and non-copper based superconductors (808-1)	3	3	12.751	0
Development of high critical current high T _c superconducting thin films for fabrication of SQUIDS and infrared detectors (808-2)	5	5	23.406	16
Material Sciences Total	229	229	1159.494	4005
Pure and Applied Chemistry				
Selective oxidation of organic compounds over vanadium silicate molecular sieves (1006-1)	9	9	56.832	211
Structure and rheological properties of wormlike micelles (1007-1)	7	7	60.682	199
Segregation and surface properties of Pt-based alloys: Experimental and theoretical approach (106-1)	3	3	10.076	65
Interfacial tension and wetting phenomena in quasibinary liquids (107-1)	22	22	180.385	458
Dynamics of microscopic and reactive processes in liquids (1106-1)	3	3	31.629	72
Catalysis of organic reactions using heterogenous modified clay catalysis (1106-2)	7	7	47.197	333
Theoretical modelling of catalytic properties of zeolites (1206-1)	4	4	16.923	55
Stereoselective chemical synthesis of herbicidins, a novel family of natural products with valuable herbicidal activity (1305-1)	1	1	0.056	19
Scientific design of flotation separation reagents based on molecular recognition at mineral surfaces (1315-1)	1	1	7.913	24
Equilibrium dynamics and morphology of thin films (1607-1)	23	23	246.646	1073
Study of the transmission of proteins through porous membrane and the fouling of the membrane (1615-1)	1	1	3.861	5
Three phase catalytic reactors: Comparison of upflow and downflow operations (1806-1)	1	1	2.393	10
Selective acylation and alkylation of reactions of aromatics using solid acid catalysts (1906-1)	22	22	52.291	181
Multi-nuclear solid state structural studies of molecular sieves (2105-1)	7	7	127.783	84
Development of photocatalysis for destruction of toxic water pollutants by advanced oxidation process (2205-2)	11	11	74.714	284

Project	Papers	Impact Factor	Impact Energy	Citations Received
Novel synthetic methodologies in combinatorial chemistry for the preparation of bio-active molecule libraries (2305-1)	3	3	24.912	128
Electrostatically controlled interaction of colloidal nanoparticles and polyelectrolytes at the air-water interface (2305-2)	11	11	100.309	273
Study of hydrogels of cationic bile salts (2605-1)	4	4	62.098	46
Modeling of zeolite framework relaxation (2605-2)	6	6	53.902	107
Effluent treatment through membrane processes (2805-1)	11	11	42.795	88
Homogeneous catalysis of oxidation of organic substrates to value added products using transition metal complexes (2905-1)	8	8	147.871	53
Biomimetic synthesis and evaluation of B-amino alcohols (3005-1)	7	7	52.408	91
Hydrogenation of unsaturated carbonyl compounds and nitriles (306-1)	2	2	4.488	111
Theory of molecular intercalation into DNA (3105-1)	3	3	31.558	43
Synthesis of novel chiral heterogenous symmetric oxidation catalysis (3105-2)	1	1	7.328	14
Design, synthesis, and biological evaluation of cationised PNAs as antisense agents ex-vivo and in-vivo (3205-1)	2	2	8.534	23
Modelling vibrational spectra of complex molecular systems with molecular dynamics technique (3305-1)	1	1	9.284	7
Catalytic reaction engineering using ionic liquids (3305-2)	1	1	3.091	2
Synthesis and biological studies of Azido and Aminohexopyranosyl Nucleosides (3405-1)	4	4	25.729	19
Chemistry and spectroscopy of PAH and their clusters (3405-3)	1	1	3.276	0
Supramolecular interactions in multichromophores (3505-1)	2	2	34.243	4
Total synthesis of new sugar mimics from cyclic polyenes (3605-1)	2	2	33.372	5
Nanostructured organic materials and composites: A bottom up approach (3605-2)	2	2	29.370	3
Synthesis and applications of mesoporous materials (3705-1)	2	2	26.193	7
Development of functionalized carbon nanotubes (3705-2)	2	2	477.064	21

Project	Papers	Impact Factor	Impact Energy	Citations Received
Non-natural peptides in asymmetric catalysis: Metal – mediated synthesis of peptide-based materials and their applications (3805-2)	1	1	14.153	1
Design and development of zeolites-supported metal catalysis in the synthesis of chemicals and chemical intermediates (506-1)	8	8	30.575	101
Deactivation due to coking and regeneration of zeolite catalysis (506-2)	19	19	105.066	309
Fluctuating interfaces and colloidal suspensions (607-1)	15	15	379.643	309
Reaction engineering of gas-liquid-liquid catalytic reactions: application to hydroformylation (806-1)	1	1	733.001	76
Segregation and surface properties of Pd-base alloys: Experimental and theoretical approach (806-2)	7	7	19.323	180
Design, mechanistic studies and biological activity of some new sensitizers for the photodynamic therapy (PDT) of tumorous cells and leukemias (905-1)	8	8	31.447	220
Interdroplets interaction and reaction rate modulation of reverse micelle mediated reactions (907-1)	2	2	0.535	11
Pure and Applied Chemistry Total	258	258	3410.949	5325
Pure and Applied Mathematics				
Asymptotic analysis in partial differential equations (1001-1)	5	5	2.892	65
Integrability aspects of discrete and continuous equations (1201-1)	11	11	14.282	89
Rigorous results on schrodinger equations and foundations of quantum theory and applications to particle physics and astrophysics (1501-2)	7	7	9.673	34
Non-linear hyperbolic and elliptical equations and applications (1601-1)	1	1	0.000	0
Geometry (1601-2)	2	2	0.536	13
Non-linear partial differential equations and control problems (1901-2)	1	1	0.112	0
Algebraic groups in arithmetic and geometry (2501-1)	3	3	2.382	27
Studies in geometry of banach spaces (2601-1)	3	3	0.724	5
Mathematical topics in hyperbolic systems of conservations laws (2601-2)	5	5	0.621	22
Advanced numerical methods in non-linear fluids mechanics and acoustics (3401-1)	4	4	18.924	8
Conservation laws and Hamilton jacobi equations (3401-2)	1	1	1.501	0

Project	Papers	Impact Factor	Impact Energy	Citations Received
Control of systems of partial differential equations (3701-1)	3	3	3.945	1
A study of some factorization and decomposition problems of graphs (401-1)	3	3	0.203	15
Non-linear hyperbolic equations and applications (501-1)	2	2	0.372	10
Geometry and Number Theory (501-2)	3	3	0.836	12
Pure and Applied Mathematics Total	54	54	57.002	301
Pure and Applied Physics				
Modelling of non-linear effects in high power optical cavities of laser interferometric gravitational wave detectors (1010-1)	1	1	2.019	15
AB initio calculations of atomic and molecular processes occurring in stars and in the interstellar medium (110-1)	10	10	38.813	188
Research and development in nonlinear integrated optical devices (1114-1)	7	7	16.360	30
Chaos, Turbulence, and collective Relaxation in Non-equilibrium Plasmas (1301-1)	1	1	3.976	18
Gravitational lensing by clusters of galaxies: A tool for physical cosmology (1410-2)	8	8	264.097	343
Development of polycrystalline silicon thin films for application in photo-voltaic devices (1414-1)	3	3	3.836	16
Ultrafast processes in low-dimensional semiconductors (1514-1)	4	4	89.966	46
Electrical characterisation and reliability of organic self-assembled monolayers for applications in advanced deep submicron devices (1614-1)	2	2	19.293	116
Collider physics (1701-1)	5	5	77.698	191
Semi-analytic modelling of structure formation (1710-1)	6	6	747.704	194
RandD in dispersion-compensated optical fibres and amplifiers (1814-1)	3	3	0.666	2
Theoretical study of electronic and structural properties of clusters using ab initio molecular dynamics (1901-1)	12	12	175.069	188
Infrared astronomy (1910-1)	1	1	14.296	5
Direct force measurements between colloidal particles (2007-1)	4	4	30.082	48
Stable solar cells based on new PECVD processes (2104-1)	10	10	37.462	74
Quark gluon plasma (2104-2)	5	5	46.045	47
Gravitational wave data analysis for the laser interferometer space antenna (2204-1)	2	2	35.216	22

Project	Papers	Impact Factor	Impact Energy	Citations Received
Study of viscous fingering in lifting hele-shaw cell (2304-1)	2	2	3.515	18
Studies of strongly correlated electron systems (2404-1)	13	13	322.100	364
Scaling and multiscaling in MHD turbulence (2404-2)	11	11	152.865	93
Precision tests of chiral perturbation theory (2504-1)	6	6	154.129	93
Interfaces in complex fluids (2504-2)	1	1	5.847	14
Dynamics of solar and stellar interiors: Seismology and activity (2504-3)	6	6	102.643	43
Surfactant effects on atomic ordering in semiconductor epilayers (2604-1)	2	2	19.600	3
Dynamics of lopsided spiral galaxies (2704-1)	6	6	120.577	227
Galaxy formation: The AGN-Spheroid Connection (2804-1)	4	4	36.974	47
Gravitational waves from neutron star binaries (2904-1)	10	10	202.328	302
Brane-world phenomenology (2904-2)	1	1	42.289	2
Susy, Higgs and CP at colliders and in astrophysics (3004-2)	16	16	298.978	108
Probing the remote universe with QSO absorption lines (3004-3)	11	11	244.708	486
Silicon-germanium thin films for solar cells applications (3104-1)	2	2	6.813	3
Electronic structure and transport properties in Nanostructures (3104-2)	17	17	204.046	132
Hot and dense matter in quantum chromodynamics (3104-3)	6	6	87.907	195
Lattice dynamical and structural study of Be-based II-VI semiconductor alloys (3204-1)	6	6	55.213	35
Rheology of dense granular flows (3404-1)	9	9	334.311	54
Statics and dynamics of low-dimensional disordered systems (3404-2)	20	20	276.105	85
Rigorous results in quantum information theory, potential scattering, and supersymmetric quantum mechanics (3404-3)	2	2	2.536	3
Wave propagation in disordered excitable media and simulated cardiac tissue (3404-4)	3	3	53.072	14
Physical and Mathematical modelling of LISA mission (3504-1)	1	1	9.211	3
The mechanics of living matter (3504-2)	23	23	2047.665	178
Systematic Effects in CMB of ESA's Satellite "Planck" (3504-3)	1	1	17.464	0

Project	Papers	Impact Factor	Impact Energy	Citations Received
Optical soliton propagation in various dielectric nonlinear media (3504–4)	14	14	78.546	62
Dilute magnetic semiconductors: Bulk and Nano (3604–1)	3	3	23.111	0
Plasmonic properties of checkerboard metallic structures and films (3804–2)	1	1	1.915	2
Memory effects in Three-Level systems (3904–1)	2	2	12.661	0
Stellar populations and galactic evolution: A photometric and astrometric sample survey (510–1)	7	7	30.707	171
Symbolic clustering of french spot satellite data for forest inventory (912–1)	4	4	0.684	3
Pure and applied Physics Total	294	294	6,551.119	4283
Technology for Information and Communication				
New Strategies for wireless communication networks (2900-IT-1)	23	23	15.115	111
Molecular scale electronics using self assembly; Electronique moleculaire auto-assemblee (3000-IT-1)	6	6	19.953	138
Emerging strategies for wireless communication networks (4000-IT-1)	1	1	0.000	0
Technology for Information and Communication Total	30	30	35.068	249
Water				
Optimal development and management of ground water in weathered fractured aquifers. (2013–W1)	4	4	1.216	24
Geochemistry of Ganga sediment and groundwater arsenic immobilization. (2200–W1)	1	1	9.753	145
Proton magnetic resonance technique in weathered-fractured aquifers. (2700–W1)	1	1	1.659	1
Hydro-Bio-geochemical cycles in two small experimental watersheds of south India. (3000–W1)	2	2	5.820	13
Water Total	8	8	18.448	183
Grand Total	1,169	1,169	15,391.124	20,086

Annexure XIII:

Year-wise Distribution of Papers in Journals

Journal	Papers	Impact Factor
1990		
Astronomy Andand Astrophysics	1	2.343
Catalysis Letters	1	0
Information Processing Letters	1	0.331
Journal of Bacteriology	1	3.557
Journal of the Less-Common Metals	2	1.303
Monthly Notices of the Royal Astronomical Society	1	2.74
Physical Review A	1	2.093
Physical Review Letters	1	7.586
Physics Letters A	1	1.142
Solid State Communications	1	2.063
1991		
Berichte Der Bunsen-Gesellschaft	1	1.066
Cellular Immunology	1	2.178
Indian Journal of Biochemistry andand Biophysics	1	0.202
Journal De Physique Iii	1	1.087
Journal De Physique Iv	1	0
Journal of Chemical Physics	1	3.568
Journal of Magnetism and Magnetic Materials	1	1.132
Journal of Thermal Analysis	1	0.21
Materials Science and Engineering B-Solid State Materials For Advanced Technology	1	0.828
Physica A	1	1.246
Physics Letters A	1	1.091
Solid State Communications	1	1.764
1992		
Astronomy and Astrophysics	1	1.821
Astrophysical Journal	1	2.931
Biochimica Et Biophysica Acta	1	2.61
Current Science	1	0.253
Europhysics Letters	1	2.463

Journal	Papers	Impact Factor
High T(C) Superconductor Thin Films	1	0
Ifip Transactions A-Computer Science and Technology	1	0
Journal of Applied Physics	2	1.532
Journal of Biological Chemistry	1	6.733
Journal of Colloid and Interface Science	1	1.42
Journal of Magnetism and Magnetic Materials	1	1.297
Journal of Materials Research	2	2.623
Journal of Physics B-Atomic Molecular and Optical Physics	3	2.268
Materials Science and Engineering B-Solid State Materials For Advanced Technology	1	0.62
Molecular Ecology	1	0
Non-Stoichiometry in Semiconductors	1	0
Physica C	1	2.044
Physical Review A	2	2.157
Physical Review Letters	1	7.375
Physics Letters A	1	1.135
Polymer	1	1.549
Polymer International	1	0.485
Pramana-Journal of Physics	2	0.39
Proceedings of the National Academy of Sciences of the United States of America	1	10.48
Rubber Chemistry and Technology	1	0.735
Sadhana-Academy Proceedings in Engineering Sciences	2	0.026
Solid State Ionics	1	1.093
Theoretical Computer Science	1	0.285
1993		
Annales De l'institut Fourier	1	0
Astronomy and Astrophysics Supplement Series	1	1.827
Astronomy and Astrophysics	1	2.122
Atomic Data and Nuclear Data Tables	1	2.175
Biochemistry and Molecular Biology International	1	0
Biology of Reproduction	1	2.782
Catalysis Letters	1	1.628
Cellular Immunology	1	2.166
Chinese Journal of Physics	1	0.322
Computer Networks, Architecture and Applications	1	0.005
Europhysics Letters	1	2.776
Fems Microbiology Letters	1	1.296

Journal	Papers	Impact Factor
Gene	1	2.407
Ieee Transactions on Magnetics	1	0.952
Ieee Transactions on Neural Networks	1	1.745
Immunogenetics	1	3.085
Journal of Adhesion	1	0.466
Journal of Alloys and Compounds	1	0.9
Journal of Applied Physics	2	1.784
Journal of Applied Polymer Science	4	0.966
Journal of Biological Chemistry	1	6.793
Journal of Chemical Physics	1	3.615
Journal of Fermentation and Bioengineering	1	0.929
Journal of Materials Chemistry	1	1.545
Journal of Medical and Veterinary Mycology	1	0.853
Journal of Molecular Catalysis	2	1.498
Journal of Molecular Structure	1	0.894
Journal of Solid State Chemistry	2	1.583
Journal of the Chemical Society-Perkin Transactions 1	1	1.545
Materials Research Bulletin	1	0.991
Molecular Biology and Evolution	1	3.902
Molecular Ecology	1	0
Nuclear Instruments and Methods in Physics Research Section B-Beam Interactions With Materials and Atoms	1	1.157
Phase Transitions	1	0.511
Physica Scripta	1	0.987
Physica Status Solidi B-Basic Research	1	0.558
Physical Review B	3	3.159
Physical Review E	1	0
Physics Letters A	1	1.149
Polymer International	1	0.777
Polymer Journal	1	0.983
Pramana-Journal of Physics	1	0.383
Research in Virology	1	1.13
Rubber Chemistry and Technology	1	1.017
Sadhana-Academy Proceedings in Engineering Sciences	1	0
Solid State Communications	1	1.539
Surface Science	1	2.639
1994		
Advanced Information Processing Techniques for Lan and Man Management	1	0.01

Journal	Papers	Impact Factor
Archives of Microbiology	1	2.126
Astronomy and Astrophysics	2	2.328
Berichte Der Bunsen-Gesellschaft	1	1.23
Biochemistry and Molecular Biology International	1	0.566
British Journal of Cancer	1	3.188
Bulletin of Materials Science	2	0.591
Carbon	1	1.619
Cellular Immunology	1	2.065
Colloids and Surfaces A-Physicochemical and Engineering Aspects	2	0.517
Europhysics Letters	2	2.662
Fourth International Conference on Factory 2000: Advanced Factory Automation	1	0
Hyperfine Interactions	1	0.59
Information Processing 94: Technology and Foundations	1	0
Journal of Applied Electrochemistry	1	0.926
Journal of Applied Physics	1	1.658
Journal of Catalysis	4	2.492
Journal of Chemical Physics	1	3.635
Journal of Macromolecular Science-Pure and Applied Chemistry	1	0.616
Journal of Materials Research	1	2
Journal of Physics and Chemistry of Solids	1	1.35
Journal of Physics-Condensed Matter	1	1.562
Journal De Physique IV	2	0.115
Macromolecules	1	3.016
Physical B	1	1.144
Physical C	7	3.258
Physical Review B	2	3.187
Physical Review E	2	1.888
Physical Review Letters	5	6.626
Physics Reports-Review Section of Physics Letters	1	6.541
Proceedings of the XVI International Cancer Congress - Free Papers and Posters, Tomes 1-4	1	0
Reaction Kinetics and Catalysis Letters	1	0.277
Research and Industry	1	0.037
Solid State Communications	1	1.446
Symposium on Logic in Computer Science - Lics'94	1	0
Tetrahedron Letters	1	2.378
Zeolites and Related Microporous Materials: State of the Art 1994	1	0

Journal	Papers	Impact Factor
1995		
American Journal of Reproductive Immunology	1	1.707
Applied Physics Letters	1	3.029
Archives of Microbiology	1	1.801
Archives of Virology	1	1.384
Atmospheric Environment	1	0.95
Biotechnology Letters	1	0.957
Carbon	1	1.436
Catalysis Letters	3	1.917
Contributions to Mineralogy and Petrology	1	2.963
Current Science	1	0.292
Fems Microbiology Letters	1	1.488
Hepatology	1	5.392
Human Reproduction	1	2.913
Hybrid Systems li	1	0
Indian Journal of Chemistry Section A-Inorganic Bio-Inorganic Physical Theoretical and Analytical Chemistry	2	0.327
International Journal of Hydrogen Energy	1	0.374
Journal of Applied Electrochemistry	1	0.689
Journal of Catalysis	1	2.974
Journal of Chemical Physics	1	3.61
Journal of Electroanalytical Chemistry	1	1.735
Journal of General Virology	1	3.41
Journal of Geology	1	1.892
Journal of Immunology	1	7.412
Journal of Magnetism and Magnetic Materials	1	1.208
Journal of Scientific andand Industrial Research	1	0.155
Journal of Solid State Chemistry	1	1.342
Journal of the Chemical Society-Chemical Communications	2	2.652
Journal of the Chemical Society-Faraday Transactions	1	1.771
Journal of the Chemical Society-Perkin Transactions 1	1	1.641
Journal of the Electrochemical Society	1	2.021
Macromolecular Symposia	1	0.73
Materials Science and Engineering B-Solid State Materials for Advanced Technology	1	0.708
Mathematics of Computation	1	0.61
Methods in Molecular and Cellular Biology	1	0
Molecular Ecology	1	2.992

Journal	Papers	Impact Factor
Nature	1	27.074
Optics Communications	2	1.193
Physical Review B	1	2.834
Physical Review E	1	2.159
Physical Review Letters	3	6.297
Plant Growth Regulation	1	1.286
Polymer and Other Advanced Materials: Emerging Technologies and Business Opportunities	1	0
Pramana-Journal of Physics	1	0.349
Scripta Metallurgica Et Materialia	1	0.912
Solid State Communications	1	1.337
Synthetic Metals	1	1.583
Tetrahedron Letters	1	2.257
Thin Solid Films	1	1.313
Zeolites	1	1.989
1996		
American Journal of Reproductive Immunology	1	1.942
Anziis 96 - 1996 Australian New Zealand Conference on Intelligent Information Systems, Proceedings	2	0
Applied Catalysis A-General	2	1.774
Archives of Physiology and Biochemistry	2	0.187
Carbon	1	1.5
Catalysis Today	1	1.791
Chemical Communications	1	3.107
Chemical Physics Letters	1	2.589
Colloids and Surfaces A-Physicochemical and Engineering Aspects	1	1.147
Comptes Rendus De l'Academie Des Sciences Serie I-Mathematique	1	0.344
Current Opinion in Solid State and Materials Science	1	0
Genome	1	1.792
Ieee Journal of Quantum Electronics	1	1.707
Igarss '96 - 1996 International Geoscience and Remote Sensing Symposium: Remote Sensing for a Sustainable Future	1	0
Indian Journal of Chemistry Section A-Inorganic Bio-Inorganic Physical Theoretical and Analytical Chemistry	1	0.395
Information Sciences	1	0.207
Inorganic Chemistry	2	2.99
International Journal of Cancer	1	3.534
International Journal of Oncology	3	1.125
International Journal of Systematic Bacteriology	1	3.929

Journal	Papers	Impact Factor
Journal De Physique Iv	1	0.186
Journal of Applied Physics	3	1.812
Journal of Biosciences	1	0.397
Journal of Catalysis	3	3.635
Journal of Clinical Biochemistry and Nutrition	1	0.25
Journal of Evolutionary Biology	1	2.022
Journal of Materials Chemistry	1	1.66
Journal of Materials Science	1	0.749
Journal of Nonlinear Optical Physics and Materials	1	0.563
Journal of Photochemistry and Photobiology B-Biology	1	1.398
Journal of Physical Chemistry	2	3.366
Journal of Solid State Chemistry	2	1.484
Journal of Structural Geology	1	1.258
Journal of the Chemical Society-Faraday Transactions	2	1.663
Journal of the Chemical Society-Perkin Transactions 1	1	1.799
Journal of the Electrochemical Society	1	1.91
Langmuir	1	3.47
Letters in Mathematical Physics	1	0.99
Macromolecular Chemistry and Physics	2	1.34
Modern Physics Letters B	1	0
Monatshefte Fur Mathematik	1	0.299
Photochemistry and Photobiology	1	2.162
Physica A	1	1.214
Physica C	1	1.723
Physical Review B	1	2.975
Physics Letters A	1	1.241
Plant and Soil	1	1.396
Proceedings of the 11th Thematic Conference - Geologic Remote Sensing: Practical Solutions For Real World Problems	1	0
Proceedings of the Indian Academy of Sciences-Chemical Sciences	2	0.4
Progress in Natural Science	1	0
Solid State Ionics	1	1.512
Synlett	1	2.766
Theoretical and Applied Genetics	1	2.313
Topology	1	0.864
Trends in NDE Science and Technology - Proceedings of the 14th World Conference on Ndt (14th Wcndt)	2	0
Unsolved Problems of the Milky Way	1	0.347

Journal	Papers	Impact Factor
1997		
Applied Catalysis A-General	1	2.02
Cellular Immunology	1	1.83
Chaos Solitons and Fractals	1	0.698
Chemistry of Materials	1	3.273
Concur'97 : Concurrency Theory	1	0
European Journal of Solid State and Inorganic Chemistry	1	0.841
Evolution	1	2.715
Fullerene Science and Technology	1	0.49
Genetics Selection Evolution	1	0.818
Indian Journal of Chemical Technology	1	0.22
International Journal of Modern Physics B	2	1.071
International Journal of Oncology	2	1.181
Journal of Alloys and Compounds	2	1.035
Journal of Applied Polymer Science	1	0.841
Journal of Biosciences	2	0.435
Journal of Catalysis	3	3.452
Journal of Chemical Physics	4	3.247
Journal of Colloid and Interface Science	1	1.646
Journal of Electroanalytical Chemistry	1	1.59
Journal of Materials Chemistry	1	1.81
Journal of Materials Research	1	1.588
Journal of Molecular Catalysis A-Chemical	1	1.478
Journal of Photochemistry and Photobiology B-Biology	1	1.381
Journal of Physical Chemistry A	1	3.392
Journal of Physical Chemistry B	1	3.392
Journal of Physics A-Mathematical and General	1	1.48
Journal of Solid State Chemistry	1	1.486
Journal of the Optical Society of America B-Optical Physics	1	2.032
Journal of Thermal Biology	1	0.78
Langmuir	1	2.852
Letters in Mathematical Physics	1	0.922
Materials Science and Engineering A-Structural Materials Properties Microstructure and Processing	1	0.842
Molecular Crystals and Liquid Crystals Science and Technology Section A-Molecular Crystals and Liquid Crystals	1	0.399
Optics Communications	1	1.258
Physical C	1	2.199

Journal	Papers	Impact Factor
Physical Review B	1	2.88
Physical Review E	2	2.233
Physics Letters A	1	1.267
Physics of Plasmas	1	1.994
Plant Disease	1	0.717
Pramana-Journal of Physics	1	0.34
Rairo-Mathematical Modelling and Numerical Analysis-Modelisation Mathematique Et Analyse Numerique	1	0.266
Rna-A Publication of the Rna Society	1	5.97
Siam Journal on Applied Mathematics	1	0.829
Synthetic Metals	1	1.254
Thin Solid Films	1	1.034
Zeolites	2	2.255
1998		
Acta Crystallographica Section C-Crystal Structure Communications	1	0.557
Advances in Computing Science-Asian' 98	2	0
Applied Catalysis A-General	1	1.553
Applied Clay Science	1	0.348
Applied Physics Letters	1	3.349
Archives of Virology	1	1.526
Automata, Languages C and Programming	1	0
Biochemical Genetics	1	0.868
Catalysis Letters	1	2.171
Chemical Communications	5	3.407
Chemical Physics Letters	2	2.257
Concur'98: Concurrency Theory	1	0
Discrete Mathematics	2	0.236
Ecological Entomology	1	1.53
Evolution	1	3.296
First International Congress on Adhesion Science and Technology - Invited Papers - Festschrift in Honor of Dr K L Mittal on the Occasion of His 50th Birthday	1	0
Genetical Research	1	1.816
Genetics	1	4.45
Journal of Applied Polymer Science	1	0.886
Journal of Biomolecular Structure and Dynamics	2	1.643
Journal of Catalysis	1	2.997
Journal of Chemical Technology And Biotechnology	1	0.844

Journal	Papers	Impact Factor
Journal of Climate	1	3.105
Journal of Colloid Andand Interface Science	1	1.679
Journal of Dispersion Science Andand Technology	1	0.311
Journal of General Virology	1	2.645
Journal of Genetics	1	0.894
Journal of Magnetism Andand Magnetic Materials	1	0.889
Journal of Molecular Catalysis A-Chemical	2	1.657
Journal of Physics A-Mathematical and General	1	1.545
Journal of Polymer Science Part A-Polymer Chemistry	1	1.237
Journal of Solid State Chemistry	2	1.432
Journal of the American Chemical Society	1	5.725
Journal of the Electrochemical Society	1	2.11
Journal of the Optical Society of America B-Optical Physics	1	1.853
Journal of Thermal Biology	2	0.642
Journal of Zoological Systematics and Evolutionary Research	1	0.93
Langmuir	3	2.813
Macromolecular Rapid Communications	1	2.302
Materials Research Bulletin	2	0.849
Materials Research Innovations	1	0.259
Materials Science and Engineering B-Solid State Materials For Advanced Technology	1	0.36
Metals Materials and Processes	1	0.033
Microporous and Mesoporous Materials	1	1.771
Optics Communications	1	1.206
Oral Oncology	1	1.265
Physical C	1	1.086
Physical Review B	2	2.842
Physical Review Letters	3	6.017
Polymer	1	1.37
Precambrian Research	1	1.73
Recent Advances in Basic and Applied Aspects of Industrial Catalysis	3	0.698
RNA-A Publication of the RNA Society	1	5.249
Tetrahedron Letters	1	2.617
1999		
American Journal of Reproductive Immunology	1	2.448
Annals of Pure and Applied Logic	1	0.426
Annual Review of Astronomy and Astrophysics	1	15.067
Applied Physics Letters	1	4.184

Journal	Papers	Impact Factor
Biological Journal of the Linnean Society	1	1.684
Biopolymers	1	2.331
Chemical Physics Letters	1	2.269
Chemistry of Materials	1	3.273
Colloids and Surfaces B-Biointerfaces	1	0.944
Comptes Rendus De L Academie Des Sciences Serie Ii Fascicule C-Chimie	1	0.236
Current Science	2	0.567
Developmental Biology	1	6.049
Earth and Planetary Science Letters	1	2.832
European Physical Journal B	1	1.705
Europhysics Letters	1	2.214
Fm'99-Formal Methods, Vol Ii	1	0.53
Fractals-Complex Geometry Patterns and Scaling in Nature and Society	1	1.041
Genetica	2	1.699
Genetics Selection Evolution	1	1
Heredity	1	1.875
Hyperbolic Problems: Theory, Numerics, Applications, Vol 1	1	0
Immunology Letters	1	1.494
Indian Journal of Pure and Applied Physics	1	0.228
Information Processing Letters	1	0.242
Inorganic Chemistry	1	2.843
International Journal For Numerical Methods in Engineering	1	1.335
International Journal of Cancer	1	3.545
International Journal of Pattern Recognition and Artificial Intelligence	1	0.5
Inverse Problems	1	1.103
Journal of Biosciences	1	0.37
Journal of Chemical Physics	2	3.289
Journal of Colloid and Interface Science	2	1.614
Journal of Computational Physics	1	1.31
Journal of Immunological Methods	1	1.95
Journal of Magnetism and Magnetic Materials	2	1.195
Journal of Materials Chemistry	3	2.317
Journal of Materials Research	1	1.574
Journal of Pathology	1	3.833
Journal of Physics A-Mathematical and General	1	1.387
Journal of Physics D-Applied Physics	1	1.188
Langmuir	1	2.937
Molecular and General Genetics	1	2.539

Journal	Papers	Impact Factor
Oral Oncology	1	1.396
Pattern Recognition	1	0.979
Physical B	1	0.725
Physics Letters B	3	3.878
Polymer	2	1.344
Pramana-Journal of Physics	2	0.278
Quaternary Research	1	1.833
Research on Chemical Intermediates	1	0.992
Thin Solid Films	2	1.101
Zeitschrift Fur Kristallographie-New Crystal Structures	1	0
2000		
Applied Physics Letters	1	3.906
Astronomy and Astrophysics	2	2.79
Biophysical Journal	1	4.462
Carbon	1	1.715
Chaos Solitons and Fractals	2	0.742
Clinical and Experimental Immunology	1	2.544
Czechoslovak Journal of Physics	1	0.298
Emulsions, Foams, and Thin Films	1	0
European Physical Journal D	1	1.421
Evolution	1	3.632
Evolution and Development	1	3.4
Formal Methods in System Design	1	0.5
Formal Techniques in Real-Time and Fault-Tolerant Systems, Proceedings	1	0.253
Genetica	1	1.44
Impact of Large-Scale Surveys on Pulsating Star Research	1	0
International Journal of Pattern Recognition and Artificial Intelligence	1	0.31
International Journal of Quantum Chemistry	1	1.317
International Journal of Remote Sensing	1	0.827
Journal of Adhesion Science and Technology	1	0.848
Journal of Algebra	1	0.534
Journal of Applied Physics	1	2.18
Journal of Biomolecular Structure and Dynamics	1	1.826
Journal of Molecular Catalysis A-Chemical	1	1.659
Journal of Non-Crystalline Solids	1	1.269
Journal of Solid State Chemistry	1	1.527
Journal of Thermal Biology	1	0.657
Langmuir	2	3.045

Journal	Papers	Impact Factor
Monthly Notices of the Royal Astronomical Society	1	4.685
Nature	1	25.814
Nuclear Physics B	1	4.225
Paleoceanography	1	3.74
Physical Review A	1	2.831
Physical Review D	1	3.838
Physical Review Letters	3	6.462
Physics Letters A	1	1.122
Precambrian Research	1	2.126
Proceedings of the Royal Society of Edinburgh Section A-Mathematics	1	0.483
Sedimentology	1	1.793
Synthetic Communications	1	0.828
Theoretical and Applied Genetics	1	2.358
2001		
Aiche Journal	1	1.793
American Journal of Reproductive Immunology	1	2.02
Applied Catalysis A-General	2	2.258
Catalysis Letters	1	1.852
Chemical Engineering Science	1	1.547
Clinical and Experimental Immunology	2	2.716
Current Science	2	0.6
Differential Geometry and Its Applications	1	0.375
European Physical Journal C	1	5.194
Evolution	1	3.74
Isss'01: 14th International Symposium on System Synthesis	1	0
Journal of Chemical Physics	1	3.147
Journal of Geophysical Research-Oceans	1	2.609
Journal of Molecular Catalysis A-Chemical	2	1.52
Journal of Non-Crystalline Solids	1	1.363
Journal of Physics A-Mathematical and General	2	1.542
Monthly Notices of the Royal Astronomical Society	3	4.681
Philosophical Magazine Letters	1	1.346
Physical Review A	3	2.81
Physical Review B	2	3.07
Physical Review Letters	2	6.668
Physics and Chemistry of the Earth Part A-Solid Earth and Geodesy	1	0.359
Plant Cell Tissue and Organ Culture	1	0.631
Precambrian Research	1	2.284

Journal	Papers	Impact Factor
Proceedings of the National Academy of Sciences of the United States of America	1	10.896
Theoretical Chemistry Accounts	1	1.277
Vlsi Design 2001: Fourteenth International Conference on Vlsi Design	2	0
2002		
Applied Catalysis A-General	2	1.915
Applied Catalysis B-Environmental	2	2.866
Astronomy and Astrophysics	3	3.781
Automata, Languages and Programming	1	0.515
Biochemical Journal	1	4.589
Blood	1	9.631
Catalysis Communications	1	0
Catalysis Letters	2	1.559
Chemical Geology	1	2.437
Colloids and Surfaces A-Physicochemical and Engineering Aspects	14	1.35
Communications on Pure and Applied Analysis	1	0
Comparative and Functional Genomics	1	0
Current Microbiology	1	1.21
Environmental Science and Technology	1	3.123
Febs Letters	1	3.912
Geochimica Et Cosmochimica Acta	1	2.756
International Journal of Modern Physics A	1	1.151
Japanese Journal of Applied Physics Part 1-Regular Papers Short Notes and Review Papers	1	1.28
Journal of Algebra	1	0.501
Journal of Alloys and Compounds	1	1.014
Journal of High Energy Physics	1	6.854
Journal of Membrane Science	1	1.965
Journal of Non-Crystalline Solids	1	1.435
Journal of Optoelectronics and Advanced Materials	1	0.446
Journal of Photochemistry and Photobiology A-Chemistry	1	1.297
Journal of Physical Chemistry B	1	3.611
Journal of Reproductive Immunology	1	2.361
Journal of Statistical Physics	1	1.537
Journal of the American Chemical Society	2	6.201
Langmuir	1	3.248
Nuclear Physics B-Proceedings Supplements	1	1.117
Organic Letters	1	3.715

Journal	Papers	Impact Factor
Phase Transitions	3	0.697
Philosophical Magazine A-Physics of Condensed Matter Structure Defects and Mechanical Properties	3	1.629
Physical Review A	3	2.986
Physical Review B	4	3.327
Physical Review D	1	4.358
Physical Review E	1	2.397
Physical Review Letters	1	7.323
Plant Cell	1	10.751
Plant Journal	2	5.85
Proceedings of the American Mathematical Society	1	0.334
Proteins-Structure Function and Genetics	1	4.096
Sadhana-Academy Proceedings in Engineering Sciences	1	0.112
Tectonics	1	2.697
Tetrahedron Letters	2	2.357
Theoretical Computer Science	1	0.417
Thin Solid Films	1	1.443
2003		
Applied Catalysis B-Environmental	1	3.476
Chemical Communications	1	4.031
Chemistry of Materials	2	4.374
Comptes Rendus Geoscience	1	0.366
Computer Aided Verification	1	0
Computer Physics Communications	1	1.17
Current Science	2	0.694
Defect Properties and Related Phenomena in Intermetallic Alloys	1	0
Discrete Mathematics	1	0.303
Environmental Technology	1	0.563
European Physical Journal A	1	2.097
European Physical Journal B	2	1.457
Europhysics Letters	1	2.075
Extremophiles	1	1.955
Indian Journal of Engineering and Materials Sciences	1	0.226
Indian Journal of Physics and Proceedings of the Indian Association For the Cultivation of Science-Part B	1	0
Journal of Materials Chemistry	1	2.659
Journal of Mathematical Physics	1	1.481
Journal of Molecular Biology	1	5.239

Journal	Papers	Impact Factor
Journal of Molecular Evolution	1	3.114
Journal of Photochemistry and Photobiology A-Chemistry	1	1.693
Journal of Physical Chemistry A	1	2.792
Journal of Physical Chemistry B	2	3.679
Journal of Physics D-Applied Physics	1	1.265
Journal of Plant Physiology	1	1.149
Journal of Statistical Physics	1	1.214
Journal of the Meteorological Society of Japan	1	1.243
Langmuir	5	3.098
Macromolecular Chemistry and Physics	1	1.39
Macromolecules	1	3.621
Mathematical Foundations of Computer Science 2003, Proceedings	1	0
Measurement Science and Technology	1	0.822
Nanotechnology	1	2.304
Nuclear Physics A	1	1.761
Philosophical Magazine Letters	1	1.314
Physica A-Statistical Mechanics and Its Applications	2	1.18
Physical Review B	4	2.962
Physical Review E	1	2.202
Physical Review Letters	1	7.035
Plant Science	1	1.652
Polymer International	1	0.861
Proceedings of the Indian Academy of Sciences-Chemical Sciences	1	0.649
Proceedings of the National Academy of Sciences of the United States of America	1	10.272
Quantum Communication, Measurement and Computing, Proceedings	1	0
Quantum Electronics	1	0.784
Smart Materials, Structures, and System, Pts 1 and 2	2	0
Solid State Nuclear Magnetic Resonance	1	1.453
Ultrasonics Sonochemistry	2	1.537
2004		
2004 International Conference on Signal Processing and Communications (SPCOM)	1	0
Annales Geophysicae	1	1.61
Annual Review of Biophysics and Biomolecular Structure	1	13.462
Applied Catalysis B-Environmental	2	4.042
Applied Physics Letters	1	4.308
Astronomy and Astrophysics	3	3.694

Journal	Papers	Impact Factor
Biotechnology and Bioengineering	1	2.216
Blood	1	9.782
Chemical Engineering Journal	1	1.383
Chemical Physics Letters	1	2.438
Classical and Quantum Gravity	1	2.941
Colloid and Polymer Science	1	1.11
Comptes Rendus Physique	1	1.122
European Physical Journal C	1	3.486
Genetics	2	4.138
IEEE Infocom 2004: The Conference on Computer Communications, Vols 1-4, Proceedings	1	0
Illinois Journal of Mathematics	1	0.38
Journal of Applied Physics	1	2.255
Journal of Biological Chemistry	1	6.355
Journal of Colloid and Interface Science	2	1.784
Journal of Geophysical Research-Space Physics	1	2.839
Journal of High Energy Physics	2	6.503
Journal of Invertebrate Pathology	1	1.06
Journal of Magnetism and Magnetic Materials	1	1.031
Journal of Membrane Science	1	2.108
Journal of Molecular Biology	2	5.542
Journal of Photochemistry and Photobiology A-Chemistry	1	2.235
Journal of Physical Chemistry A	1	2.639
Journal of Physical Chemistry B	1	3.834
Journal of the Geological Society of India	1	0.345
Langmuir	1	3.295
Lectures on the Physics of Highly Correlated Electron Systems Viii	1	0
Materials Science and Engineering B-Solid State Materials For Advanced Technology	1	0.924
Molecular Microbiology	1	5.959
Monthly Notices of the Royal Astronomical Society	1	5.238
New Journal of Physics	1	3.095
9th International Workshop on Frontiers in Handwriting Recognition, Proceedings	1	0
Nuclear Instruments and Methods in Physics Research Section B-Beam Interactions With Materials and Atoms	1	0.997
Organic Letters	1	4.195
Physical Chemistry Chemical Physics	1	2.076
Physical Review B	6	3.075

Journal	Papers	Impact Factor
Physical Review D	1	5.156
Physical Review E	2	2.352
Physical Review Letters	4	7.218
Physics Letters B	2	4.619
Plant Cell Reports	1	1.457
Plant Physiology	3	5.881
Proceedings of the American Mathematical Society	1	0.508
Proceedings of the Royal Society of Edinburgh Section A-Mathematics	2	0.487
Research in Microbiology	1	2.301
Trends in Microbiology	1	7.748
2005		
American Journal of Mathematics	1	0.978
Applied Physics Letters	1	4.127
Astronomy and Astrophysics	7	4.223
Biomacromolecules	1	3.618
Carbohydrate Research	1	1.669
Catalysis Communications	1	2.098
Chemical Engineering and Technology	1	0.678
Classical and Quantum Gravity	2	2.938
Computers and Chemical Engineering	1	1.501
Current Genetics	1	2.346
Desalination	1	0.955
8th International Conference on Document Analysis and Recognition, Vols 1 and 2, Proceedings	1	0
European Physical Journal B	1	1.72
Genetics	1	4.289
Geophysical Research Letters	1	2.491
Icc 2005: Ieee International Conference on Communications, Vols 1-5	1	0
IEEE Infocom 2005: the Conference on Computer Communications, Vols 1-4, Proceedings	3	0
Integrative and Interdisciplinary Aspects of Intermetallics	1	0
International Journal of Phytoremediation	1	1.288
Journal of Applied Physics	4	2.498
Journal of Cell Science	1	6.543
Journal of Chemical Physics	1	3.138
Journal of Fish Diseases	1	1.661
Journal of Membrane Science	1	2.654
Journal of Physical Chemistry B	1	4.033

Journal	Papers	Impact Factor
Journal of Physics-Condensed Matter	1	2.145
Macromolecular Chemistry and Physics	1	2.111
Macromolecules	4	4.024
Mathematische Annalen	1	0.828
Monthly Notices of the Royal Astronomical Society	2	5.352
Networking 2005: Networking Technologies, Services, and Protocols; Performance of Computer and Communication Networks; Mobile and Wireless Communications Systems	1	0.302
Nuclear Instruments and Methods in Physics Research Section B-Beam Interactions With Materials and Atoms	2	1.181
Performance Challenges For Efficient Next Generation Networks, Vols 6a-6c	1	0
Physical Review B	5	3.185
Physical Review D	2	4.852
Physical Review E	1	2.418
Physical Review Letters	3	7.489
Physics Letters B	1	5.301
Plant Cell Reports	1	2.173
Polymer-Solvent Complexes and Intercalates V	2	0.913
Probability in the Engineering and Informational Sciences	1	0.731
Proceedings of the Indian Academy of Sciences-Mathematical Sciences	1	0.154
Proceedings of the National Academy of Sciences of the United States of America	1	10.231
Proceedings of the Third International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks	2	0
Radiation Measurements	1	1.023
Separation and Purification Technology	1	1.752
Small	1	0
Tetrahedron Letters	1	2.477
Wireless Systems and Mobility in Next Generation Internet	1	0.302
World Journal of Microbiology and Biotechnology	1	0.634
2006		
2006 Ieee 63rd Vehicular Technology Conference, Vols 1-6	1	0
2006 4th International Symposium on Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks, Vols 1 and 2	2	0
25th Ieee International Conference on Computer Communications, Vols 1-7, Proceedings Ieee Infocom 2006	1	0
Acta Physica Polonica B	2	0.882
Analytica Chimica Acta	1	2.894

Journal	Papers	Impact Factor
Applied Physics Letters	1	3.977
Aquaculture	1	2.081
Astronomy and Astrophysics	3	3.971
Astrophysical Journal	1	6.119
Bioorganic and Medicinal Chemistry Letters	1	2.538
Catalysis Communications	1	1.878
Chemical Engineering Journal	1	1.594
Chemistry-A European Journal	1	5.015
Computer Networks	1	0.631
Current Science	1	0.737
Diseases of Aquatic Organisms	1	1.509
Glycobiology	1	3.668
Hydrogeology Journal	1	1.288
Immunology Letters	1	2.352
Indian Journal of Chemistry Section A-Inorganic Bio-Inorganic Physical Theoretical and Analytical Chemistry	1	0.631
Inorganica Chimica Acta	1	1.674
Journal Fur Die Reine Und Angewandte Mathematik	1	0.86
Journal of Applied Physics	1	2.316
Journal of Biological Chemistry	1	5.808
Journal of Chemical Physics	1	3.166
Journal of Convex Analysis	1	0.567
Journal of Molecular Catalysis A-Chemical	2	2.511
Journal of Organic Chemistry	1	3.79
Journal of Physical Chemistry A	2	3.047
Journal of Physical Chemistry B	1	4.115
Journal of Physics-Condensed Matter	2	2.038
Monthly Notices of the Royal Astronomical Society	1	5.057
Nuclear Instruments and Methods in Physics Research Section B-Beam Interactions With Materials and Atoms	1	0.946
Nuclear Physics A	1	2.155
Oikos	1	3.381
Optics Communications	1	1.48
Parasitology Research	1	1.14
Physica A-Statistical Mechanics and Its Applications	1	1.311
Physica Status Solidi A-Applications and Materials Science	2	1.221
Physical Review B	4	3.107
Physical Review D	2	4.896

Journal	Papers	Impact Factor
Physical Review E	1	2.438
Physical Review Letters	1	7.072
Physics Letters B	2	5.043
Plant Cell Reports	2	1.727
Plant Cell Tissue and Organ Culture	1	0.951
Plos One	1	0
Polymer	1	2.773
Pramana-Journal of Physics	1	0.417
Separation and Purification Technology	2	2.497
Synlett	1	2.838
Tetrahedron Letters	2	2.509
Wireless Networks	1	0.812
2007		
2007 5th International Symposium on Modelling and Optimization in Mobile, Ad Hoc and Wireless Networks and Workshops, Vols 1-2	1	0
2007 Ieee International Symposium on A World of Wireless, Mobile and Multimedia Networks, Vol 1	1	0
Analytical Biochemistry	1	3.002
Applied Physics Letters	1	3.596
Archives of Virology	1	1.839
Arkivoc	1	1.253
Astronomy and Astrophysics	3	4.259
Astrophysics and Space Science	1	0.834
At the Edge of the Universe: Latest Results from the Deepest Astronomical Surveys	1	0
Atmospheric Chemistry and Physics	1	4.865
Biochemistry	1	3.368
Bioorganic and Medicinal Chemistry Letters	1	2.604
Catalysis Communications	1	2.394
Catena	1	1.346
Classical and Quantum Gravity	1	2.846
Comptes Rendus Mathematique	1	0.35
Environmental Chemistry	1	2.809
Epl	3	2.206
European Journal of Organic Chemistry	1	2.914
Fems Microbiology Letters	1	2.274
Ieee-Acm Transactions on Networking	2	1.831
International Journal of Modern Physics B	1	0.647

Journal	Papers	Impact Factor
International Journal of Pharmaceutics	1	2.408
Journal of Applied Physics	1	2.171
Journal of Biological Chemistry	1	5.581
Journal of Chemical Physics	2	3.044
Journal of Computational Physics	1	2.372
Journal of High Energy Physics	1	5.659
Journal of Molecular Catalysis A-Chemical	3	2.707
Journal of Physical Chemistry A	1	2.918
Journal of Physical Chemistry B	1	4.086
Journal of Physical Chemistry C	1	0
Journal of Statistical Mechanics-Theory and Experiment	2	2.418
Lagrangian and Hamiltonian Methods For Nonlinear Control 2006	1	0
Microbiology-Sgm	1	3.11
Modern Physics Letters A	1	1.455
Monthly Notices of the Royal Astronomical Society	1	5.249
Mycopathologia	1	1.28
New Journal of Physics	2	3.264
Optics Letters	1	3.711
Parasitology International	1	1.776
Parasitology Research	1	1.512
Photonics and Nanostructures-Fundamentals and Applications	1	2
Physical Biology	1	3.108
Physical Review B	7	3.172
Physical Review E	4	2.483
Physical Review Letters	5	6.944
Physics Letters A	1	1.711
Physics Letters B	1	4.189
Planta Medica	1	1.848
Plos Genetics	1	8.721
Pramana-Journal of Physics	2	0.383
Proceedings of the National Academy of Sciences of the United States of America	1	9.598
Protein Expression and Purification	1	1.94
Science	1	26.372
Solid State Communications	1	1.535
Tetrahedron	1	2.869
2008		
Annual Review of Fluid Mechanics	1	9.314

Journal	Papers	Impact Factor
Applied Microbiology and Biotechnology	1	2.569
Carbohydrate Research	2	1.96
Cell	1	31.253
Cell Cycle	1	4.12
Chembiochem	1	3.322
Chemical Biology and Drug Design	1	2.375
Classical and Quantum Gravity	2	3.035
Coordination Chemistry Reviews	1	10.566
Current Microbiology	1	1.33
Developmental Biology	1	4.416
Diseases of Aquatic Organisms	1	1.586
Embo Reports	1	7.099
Epl	1	2.203
Eukaryotic Cell	1	3.83
European Journal of Physics	1	0.625
European Physical Journal C	1	2.805
Fems Microbiology Letters	1	2.021
Fish and Shellfish Immunology	1	3.161
Helvetica Chimica Acta	1	1.396
Hydrological Processes	1	2.002
Ieee Journal of Quantum Electronics	1	2.413
Ieee-Acm Transactions on Networking	1	2.576
Inorganic Chemistry	1	4.147
Journal of Chemical Physics	3	3.149
Journal of Chemical Sciences	2	0.745
Journal of Fluid Mechanics	1	2.315
Journal of Genetics and Genomics	1	0.358
Journal of Geophysical Research-Atmospheres	1	3.147
Journal of High Energy Physics	1	5.375
Journal of Mathematical Physics Analysis Geometry	1	0
Journal of Non-Crystalline Solids	1	1.449
Journal of Optics A-Pure and Applied Optics	2	1.742
Journal of Peptide Science	1	1.654
Journal of Physical Chemistry B	2	4.189
Journal of Physics A-Mathematical and Theoretical	1	1.54
Journal of Physics B-Atomic Molecular and Optical Physics	1	2.089
Journal of Statistical Mechanics-Theory and Experiment	2	2.758
Journal of the Optical Society of America B-Optical Physics	2	2.181

Journal	Papers	Impact Factor
Microbiology-Sgm	1	2.841
Nuclear Physics A	1	1.959
Nuclear Physics B	1	4.158
Optics Communications	1	1.552
Optics Express	1	3.88
Organic Letters	1	5.128
Physical Review B	2	3.322
Physical Review D	4	5.05
Physical Review E	3	2.508
Physical Review Letters	2	7.18
Physics of Fluids	1	1.738
Planta Medica	1	1.96
Proceedings of the National Academy of Sciences of the United States of America	1	9.38
Tetrahedron	2	2.897
Tuberculosis	1	1.758
Vaccine	1	3.298
Vibrational Spectroscopy	1	1.81
Virus Research	1	2.429
2009		
Acta Mechanica	1	1.137
Applied Mathematics and Optimization	1	0.757
Applied Surface Science	1	1.616
Aquaculture	1	1.925
Astronomy and Astrophysics	1	4.179
Bioessays	1	5.125
Biomaterials	1	7.365
Biophysical Journal	1	4.39
Cell Cycle	1	4.087
Chaos Solitons and Fractals	1	3.315
Chemical Society Reviews	1	20.086
Chemistry of Materials	1	5.368
Circulation	1	14.816
Clinical Reviews in Allergy and Immunology	1	2.597
Complex Dynamics in Physiological Systems: From Heart To Brain	1	0
Comptes Rendus Physique	2	1.384
Computers and Structures	1	1.44
Control and Cybernetics	1	0.378

Journal	Papers	Impact Factor
Dalton Transactions	3	4.081
Earth and Planetary Science Letters	1	4.062
European Physical Journal E	1	2.019
Febs Letters	1	3.541
Genes and Development	1	12.075
Industrial and Engineering Chemistry Research	1	1.758
Isij International	1	0.902
Israeli Journal of Aquaculture-Bamidgeh	1	0.313
Journal of Bacteriology	1	3.94
Journal of Chemical Physics	2	3.093
Journal of Computational Physics	2	2.369
Journal of Fluid Mechanics	2	2.283
Journal of Geophysical Research-Atmospheres	1	3.082
Journal of High Energy Physics	1	6.019
Journal of Immunology	1	5.646
Journal of Mathematical Analysis and Applications	1	1.225
Journal of Mathematical Chemistry	1	1.381
Journal of Nanoscience and Nanotechnology	1	1.435
Journal of Natural Products	1	3.159
Journal of Nuclear Materials	1	1.933
Journal of Optics A-Pure and Applied Optics	1	1.198
Journal of Organic Chemistry	1	4.219
Journal of Physical Chemistry B	1	3.471
Journal of the American Chemical Society	1	8.58
Metallurgical and Materials Transactions A-Physical Metallurgy and Materials Science	1	1.564
Molecular Pharmaceutics	1	5.408
Nature Immunology	1	26
Network Control and Optimization	1	0
Oncogene	1	7.135
Optics Express	1	3.278
Organic and Biomolecular Chemistry	1	3.762
Philosophical Transactions of the Royal Society A-Mathematical Physical and Engineering Sciences	1	2.295
Physica Status Solidi C - Current Topics in Solid State Physics, Vol 6, No 10	1	0
Physical Review B	3	3.475
Physical Review D	1	4.922
Physical Review E	7	2.4

Journal	Papers	Impact Factor
Physical Review Letters	5	7.328
Physics of Fluids	1	1.638
Polyhedron	1	2.207
Powders and Grains	1	0
Proceedings of the National Academy of Sciences of the United States of America	1	9.432
Scripta Materialia	1	2.949
Solid State Communications	1	1.837
Systems and Control Letters	1	1.797
Tetrahedron Letters	1	2.66



List of Abbreviations

AIIMS	All India Institute of Medical Sciences, Delhi
AMU	Aligarh Muslim University, Aligarh
BHU	Banaras Hindu University, Banaras
BARC	Bhabha Atomic Research Centre, Mumbai
BRGM	Bureau de Recherches Géologiques et Minières
C	Citations
CCMB	Centre for Cellular and Molecular Biology, Uppal Road, Hyderabad, Andhra Pradesh, 500007
CDRI	Central Drug Research Institute, Chatter Manzil Palace, Post Box No. 173, Lucknow, Uttar Pradesh, 226001
CEA	Commissariat à l'énergie atomique
CFTRI	Central Food Technological Research Institute, Mysore
CLRI	Central Leather Research Institute, Adayar, Chennai, Tamilnadu, 600020,
CNRS	Centre National de la Recherche Scientifique
CSIR	Council for Scientific and Industrial Research, Delhi
CSMCRI	Central Salt and Marine Chemicals Research Institute, Bhavnagar
DU	Delhi University, Delhi
E-index	Energy Index (C2/P) Last five year target window for papers for the next census year for citation
ENS	Ecole normale supérieure
ESPCI	Ecole supérieure de physique et de chimie industrielles de la ville de Paris
IAP	Institut d'astrophysique de Paris
IE	Impact Energy (IF2×P) for a year

IF	Impact Factor
IGIB	Institute of Genomics and Integrative Biology, University Campus, Mall Road, New Delhi, Delhi – 110007
IICB	Indian Institute of Chemical Biology; 4 Raja S C Mullick Road, Jadavpur, Kolkata, West Bengal, 700032
IICT	Indian Institute of Chemical Technology, Uppal Road, Hyderabad, Andhra Pradesh, 500007,
IIIM	Indian Institute of Integrative Medicine, Cannaal Road, Jammu, Jammu and Kashmir, 180001
IISc	Indian Institute of Science, Bangalore
IITR	Indian Institute of Toxicology Research, Lucknow
IITs	Indian Institute of Technology (Chennai, Delhi, Guwahati, Kanpur, Kharagpur, Mumbai, and Roorkee)
IMT	Institute of Microbial Technology, Sector 39 A, Chandigarh-160036,
INSERM	Institut National de la Santé et de la Recherche Médicale
IP	Institut Pasteur
IUCAA	Inter-University Centre for Astronomy and Astrophysics, Pune
NCL	National Chemical Laboratory, Pashan Road, Pune, Maharashtra, 411008,
NIIST	National Institute for Interdisciplinary Science and Technology, Industrial Estate, Thiruvananthapuram, Kerala-695019
P	Papers
SCI	Science Citation Index database from Thomson Reuters
TIFR	Tata Institute of Fundamental Research, Mumbai
UPMC	Université Pierre et Marie Curie



Author Profiles

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Prof. Sujit Bhattacharya is a PhD from the Indian Institute of Technology, Delhi and MSc (Physics) from the University of Delhi. He is presently working as a Professor in the Academy of Scientific and Innovation Research (ACSIR), as a Senior Principal Scientist in CSIR-NISTADS, and Editor-in-Chief of the Journal of Scientometric Research (published by Wolters|Kluvers Health). His main areas of work include Science and Technology Policy Studies, Scientometrics, and studying IPR in the context of Research, Innovation, and Development. He has published widely in the aforesaid areas.

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Dr Praveen Sharma is a PhD from the Jawaharlal Nehru University and MSc (Physics) from the University of Delhi. She is presently serving as a Technical Officer in CSIR-NISTADS. Her key areas of research interests are Mathematical Modelling and Science Measurement. She has a number of research publications and project reports to her name in these two fields.

Ms Shilpa

Ms Shilpa is a Research Scholar at CSIR-NISTADS. She is doing her PhD in Mathematical and Information Sciences from the Academy of Scientific Research and Innovation. Her research areas include Scientometrics, Information retrieval systems, and Data networks. She has published in several peer-reviewed journals in this field.

Mr Arshia Kaul

Mr Arshia Kaul has recently joined CSIR-NISTADS as a Research Fellow after completing her project tenure in this project. She holds an MSc degree in Operational Research and is pursuing her MPhil from the Department of Operational Research, University of Delhi. Her research is in mathematical modelling. She is also developing competency in quantitative research techniques.

Mr Fayaz Ahmad Sheikh

Mr Fayaz Ahmad Sheikh was a Senior Project Fellow associated with this project. He is a PhD Scholar at the Centre for Studies in Science Policy, Jawaharlal Nehru University, New Delhi. His research area includes innovations particularly informal innovations and informal economy. He actively contributes in these fields and also writes monthly columns in Greater Kashmir and Rising Kashmir.

Ms Noklenyangla

Ms Noklenyangla (aka Ayangti Longkumer) was a Senior Project Fellow attached to this project. She is a Ph.D scholar at the Centre for Studies in Science Policy, Jawaharlal Nehru University, New Delhi. Her main areas of research interest are Science, Technology, and Society Studies and Impacts of Institutions in Policy making. Apart from these, she engages in creative, technical, and mainstream writings.